MECHANICAL ENGINEERING

• APRIL 1952 •

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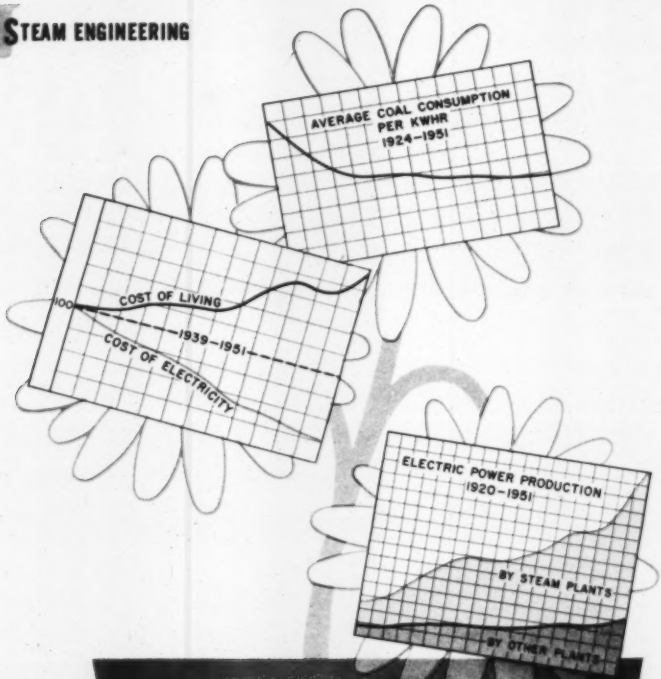
THE ECONOMICS OF STEAM ENGINEERING



AMERICA'S BIGGEST BARGAIN

STEMS FROM

STEAM

Take a quick look at the stubs in your check book —compare what you paid last month for electric power with what you paid for other essential services —and you'll agree that rising costs and shrinking dollars simply don't apply to electricity, for 70 years America's biggest bargain.

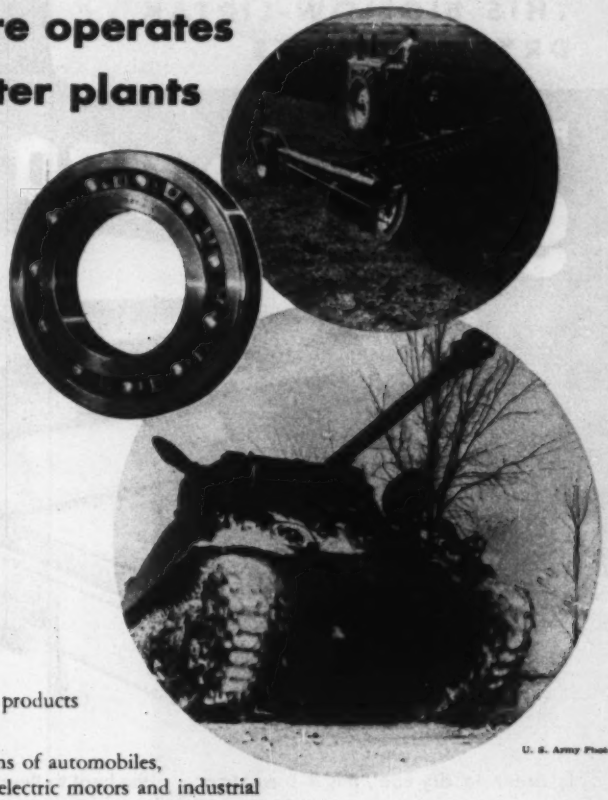
Steam is big business in America's electric power industry—70 per cent of all electricity is produced by steam-operated equipment, because steam is the most economical medium for harnessing fuel energy. Reflected in the steady decline in power rates are decades of cooperative technological progress by power company engineers and manufacturers of steam generating equipment.

The three little charts reflect how steam engineering progress has blossomed . . . how steam cultivates and holds the interest of physicists, mechanical engineers, metallurgists, civil engineers and a host of other technical men whose knowledge and experience have been applied to developing and applying equipment for the efficient conversion of fuels into usable energy. The charts forecast what the professional curiosity of America's young engineers will produce in years to come in the fertile field of steam engineering.

BABCOCK & WILCOX

G-554

New Departure operates guns-and-butter plants



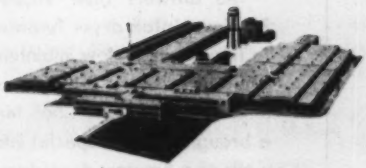
U. S. Army Photo

Ball bearings are essential to the products of our industrial might.

The ball bearings that serve millions of automobiles, trucks, tractors, farm implements, electric motors and industrial machinery are of the same materials, the same heat treatment, the same methods of precision manufacture as those required for mechanized warfare and electronic instruments. Thus conversion from one to the other at New Departure is largely a matter of changing the emphasis on types and sizes.

The productive capacities of the world's largest ball bearing factories are your assurance of the best possible production of your requirements.

New Departure's engineers and vast resources for research are freely at your disposal.



New Departure's plant at Sandusky, Ohio, where ball bearings are produced for *both* industry and the Armed Forces.

NEW DEPARTURE

Nothing Rolls Like a Ball... **BALL BEARINGS**

NEW DEPARTURE • DIVISION OF GENERAL MOTORS • BRISTOL, CONNECTICUT

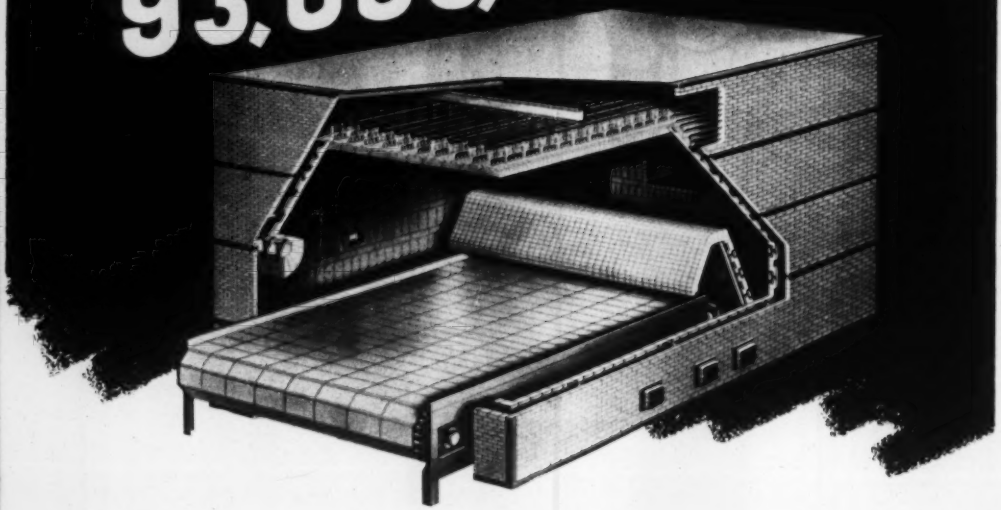
164

MECHANICAL ENGINEERING, April, 1952, Vol. 74, No. 4. Published monthly by The American Society of Mechanical Engineers, at 20th and Northampton Sts., Easton, Pa. Editorial and Advertising departments, 29 West 39th St., New York 18, N. Y. Price to members and affiliates one year $3.50, single copy 50¢; to nonmembers one year $7.00, single copy 75¢. Postage to Canada, 75¢ additional, to foreign countries $1.50 additional. Entered as second-class matter December 21, 1920, at the Post Office at Easton, Pa., under the Act of March 3, 1879. Member of the Audit Bureau of Circulations.

THIS BIGELOW-LIPTAK DRYER FURNACE

PROVIDES

93,000,000 BTU's



In order to dry coal, this B-L customer wanted a large volume of heat delivered to dryers at a temperature of 1200° F.

The answer? Their 93,000,000 BTU Bigelow-Liptak dryer furnace.

They'll enjoy low maintenance costs. Inherent in every B-L furnace design is long refractory life. Cool, tempering air is brought through special inlet tile in the walls of a Bigelow dryer furnace, saving the refractories and gradually reducing the heat to the required outlet temperature. Unit suspension of tile makes installation easy, too.

While this furnace is equipped with a spreader stoker with continuous ash discharge, any kind of firing can be employed. Too, while the application here is coal, it could be for sugar, salt, grain, lumber, etc.

Write for the new B-L catalog on dryer furnaces today!

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BIGELOW-LIPTAK

Unit-Suspended Walls & Arches

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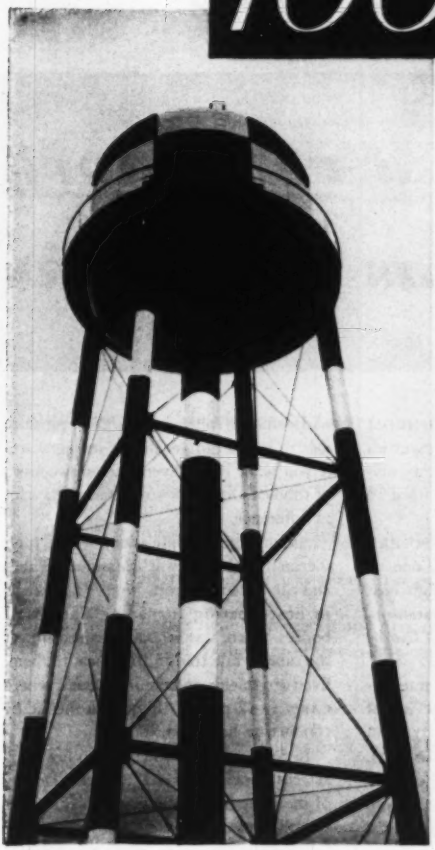
HOW 16½ ACRES STAND BEHIND

100,000 gals.



Posey Iron's 16½ acres of modern plant (under roof) stood behind the prompt delivery and sound construction of this 100,000 gallon elevated tank. Forty-one years of Posey Iron experience helped assure dependable engineering and design.

Posey Iron is equipped to do the complete job . . . from helping you determine correct type and size straight through to stress relieving, x-raying, pickling, painting and erection. The facilities of two large plate shops, an up-to-the-minute machine shop and a large foundry eliminate needless delays. Posey fabricates to meet both standard and special requirements in tanks up to all capacities. Write today for free 12-page reference bulletin.

This 16'6" vertical boring mill is one of the many tools recently added to Posey Iron's machine shop. This shop is fully equipped for the diversified machining operations demanded by Posey's different divisions.

PARTIAL LIST OF PRODUCTS

Tanks	Pressure Vessels
Dredge Pipe	Gas Holders
•	•
Digesters	Kilns
Stacks	Stills
•	•
Stand Pipes	Autoclaves

General Steel Plate Fabrication

POSEY IRON WORKS, INC.

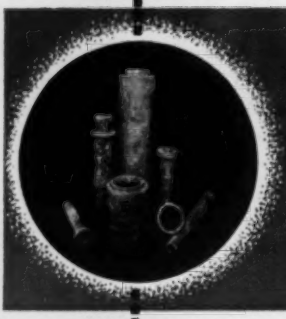
Steel Plate Division

LANCASTER, PA.

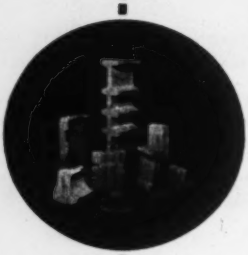
New York Office: Graybar Building

ESTABLISHED SINCE 1910

This series of advertisements is presented in the belief that there are chemical, metallurgical and other engineers who will find in some of the properties of Super Refractories by CARBORUNDUM the key to new or more effective uses of heat—and of refractories. We would like to talk over specific jobs with anyone who sees such possibilities.



Here's a refractory as rapidly as



Super Refractories by CARBORUNDUM possess a number of interesting properties not usually associated with refractory materials—properties that can be used to obtain unusual results.

Among these products are CARBOFRAX silicon carbide refractories. And one of their unusual characteristics is high heat conductivity. *At elevated temperatures, this property closely approximates that of nickel-chromium alloy steels.*

This characteristic has led to interesting applications. For example, it is not obvious that high heat conductivity is an advantage in checker brick—but it is. CARBOFRAX brick, when used in checker work, absorb—and deliver—two to five times as much heat as fireclay brick in a given period of time. You can recover more heat with fewer brick (and therefore with smaller regenerators, less pressure loss.) Or you can get higher temperatures if you want them. Even one or two rows of CARBOFRAX brick will often make a lot of difference.

Among other applications where high thermal conductivity is important: Tubes and tile in recuperators. Muffles or hearths in heat-treating furnaces. Water-wall boilers, where CARBOFRAX shapes protect the tubes while transmitting heat to them. Even arc shields on circuit breakers, where CARBOFRAX plates help quench the arc by conducting heat from it.

In the box below you'll find other characteristics of this unusual material. Do any of these suggest applications to you? If so, we'd like to discuss them with you, either in person or by letter. Won't you write or call us at Perth Amboy, N. J.?

These are some of the characteristics of CARBOFRAX Super Refractories

- They readily withstand temperatures up to 2800°F and under certain conditions up to 3200°F.
- Their resistance to abrasion is excellent. (An application: In slab-heating furnaces, CARBOFRAX skid rails have proved superior to alloy steel and water-cooled pipes.)
- They are far stronger, in all temperature ranges, than practically all other refractories.
- In most cases, they'll outlast ordinary refractories many times.
- The coefficient of expansion is very low—.000005 per degree C between 25° and 1400°C. Spalling is rarely experienced.
- They remain extremely hard at most furnace temperatures, and therefore offer no footing for clinker or slag accumulations.

that CONDUCTS heat

chrome-nickel steels

Could you use this material to get . . .

- highly efficient vertical retorts?
- more effective muffles and hearths?
- more productive regenerative equipment?
- better heat transfer in any process involving either high or moderate temperatures?

CARBOFRAX refractories are available as brick and as special shapes molded to very close tolerances—including fitted joints, tubes, etc. They are not, however, a universal cure-all, and should be applied with caution where iron oxides or basic fluxes are present at high temperatures. Under such conditions, other CARBORUNDUM Super Refractories, particularly MULLFRAX electric furnace mullite or ALFRAX electrically fused alumina, will probably prove better fitted.

We have a booklet which outlines all Super Refractories by CARBORUNDUM. You'll find information about refractory materials which, for example, are chemically inert, or highly erosion resistant, or light in weight, etc.

The "custom-made" qualities of these special purpose refractories may go hand-in-glove with your uses of heat. Why not check up? The coupon will bring you the story—or one of our engineers will be happy to talk over possibilities. We believe it could be mutually profitable.

THE CARBORUNDUM COMPANY
Refractories Division **Perth Amboy, N. J.**

"Carborundum," "Carbofrax," "Mullfrax" and "Alfrax" are registered trademarks which indicate manufacture by The Carborundum Company.

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Perth Amboy, New Jersey
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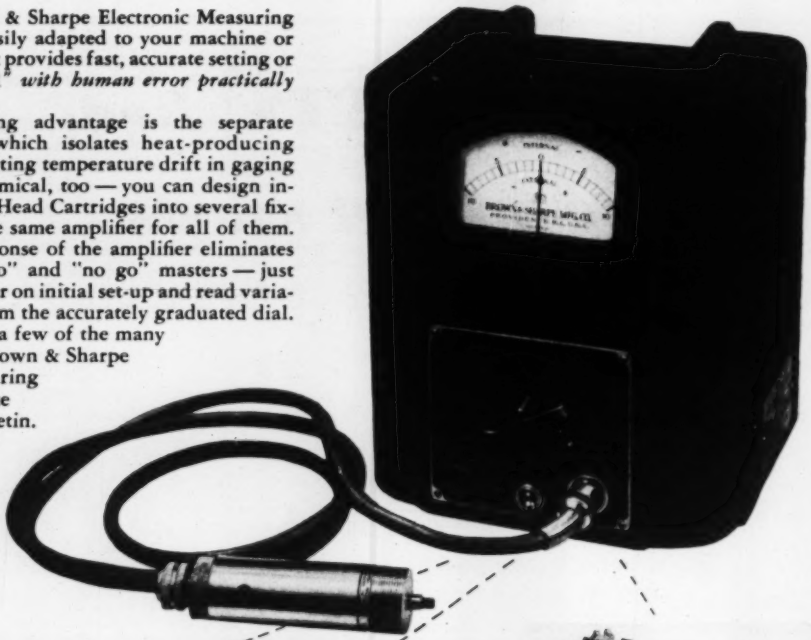
Build *"tenths of tenths"* measuring into your equipment

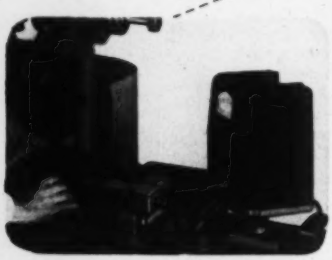
Brown & Sharpe Electronic Amplifier No. 950 for .0001" to .00001" readings. Gage Head Cartridge No. 953 is plugged in.



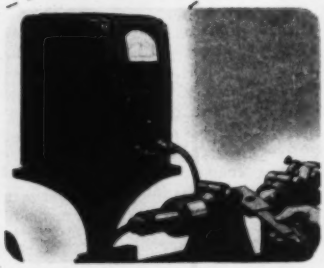
Versatile Brown & Sharpe Electronic Measuring Equipment is easily adapted to your machine or fixture design. It provides fast, accurate setting or gaging to .00001" *with human error practically eliminated.*

An outstanding advantage is the separate amplifier unit which isolates heat-producing elements, preventing temperature drift in gaging units. It's economical, too — you can design inexpensive Gage Head Cartridges into several fixtures and use the same amplifier for all of them. True linear response of the amplifier eliminates the need for "go" and "no go" masters — just "zero" the pointer on initial set-up and read variations directly from the accurately graduated dial.

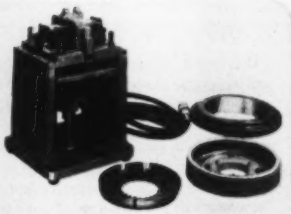
These are but a few of the many advantages of Brown & Sharpe Electronic Measuring Equipment. Write for detailed Bulletin. Brown & Sharpe Mfg. Co., Providence 1, R. I., U. S. A.



Electrolign — an application of this precision electronic equipment in Brown & Sharpe's own grinding machines. Permits fast, accurate setting of swivel table for precision grinding straight work or exact tapers after a single trial grind.



Gage Head Cartridge No. 953 mounted on fixture to measure a fixed gage . . . used with Amplifier No. 950. Standard comparators for external or internal measuring also available.

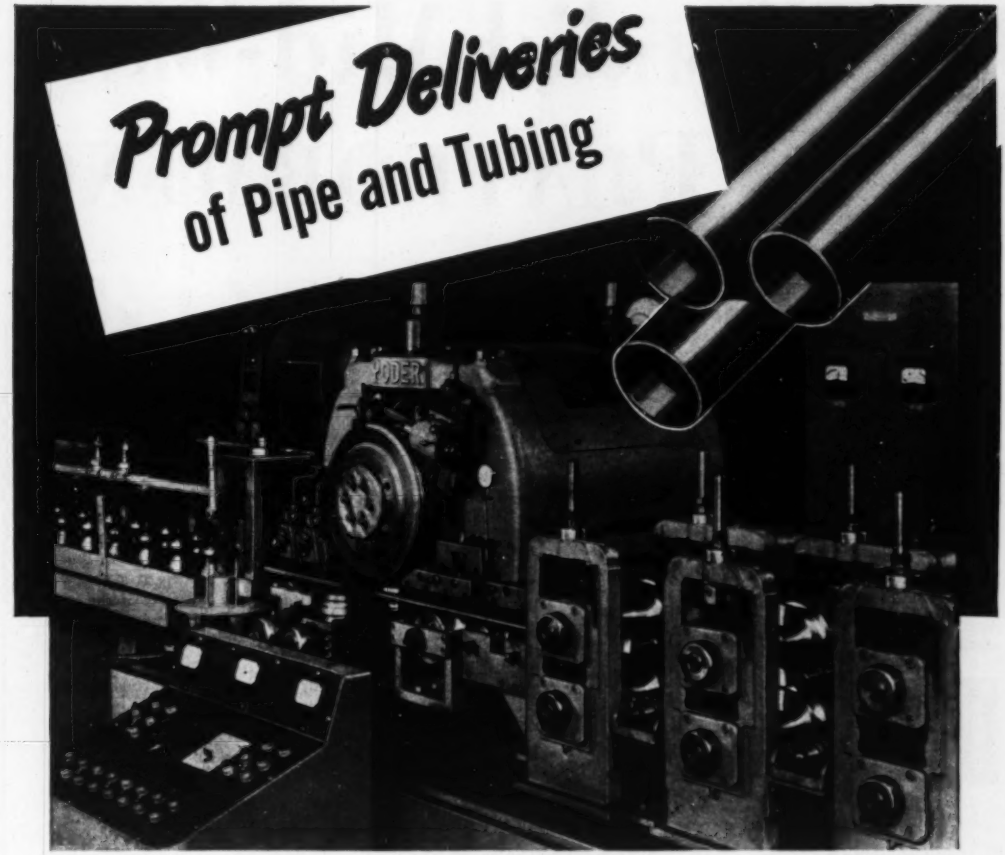


Special fixture utilizes Gage Head Cartridge and Amplifier to measure internal angle accuracy to ± 1½ seconds independently of bore size and without reference to locating surface.

WE URGE BUYING THROUGH THE DISTRIBUTOR

Brown & Sharpe B·S

Prompt Deliveries of Pipe and Tubing



may be realized by installing a low-cost Yoder Cold-Roll-Forming, Electric-Weld Tube Mill. Cold or hot rolled strip is fed continuously into the mill, coming out as finished pipe or tubing, automatically cut to length.

Yoder mills are notable for their low first cost, high speed, low labor and maintenance cost. They offer not only the highest production per dollar of investment, but for most requirements also the lowest conversion cost per ton, in making sizes from ¼″ up to 30″ diameter.

Through recent exclusive Yoder developments, higher production is now obtainable than ever before. For sizes up to 3″ dia., speeds up to 250 fpm are obtainable with a Yoder-Tocco induction welder incorporated in a Yoder mill.

For making the largest sizes, when tonnage requirements are not too high, the initial investment may be greatly reduced with a Yoder Press-forming, Arc-weld mill.

Yoder offers you the widest choice of mills of proven performance. Over 150 Yoder Pipe and Tube Mills are now in successful operation all over the world. Literature and further information on request.

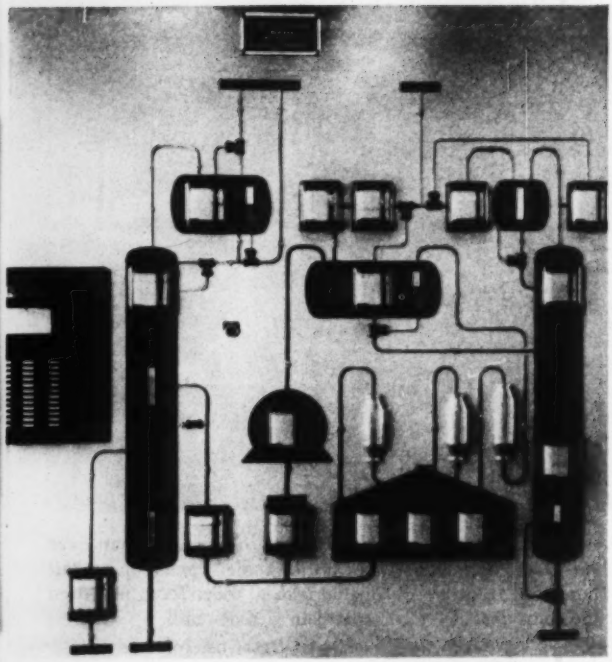
THE YODER COMPANY • 5499 Walworth Ave., Cleveland 2, Ohio

Complete Production Lines

- ★ **COLD-ROLL-FORMING and auxiliary machinery**
- ★ **GANG SLITTING LINES for Coils and Sheets**
- ★ **PIPE and TUBE MILLS**–cold forming and welding

ENGINEERING YODER MANUFACTURING

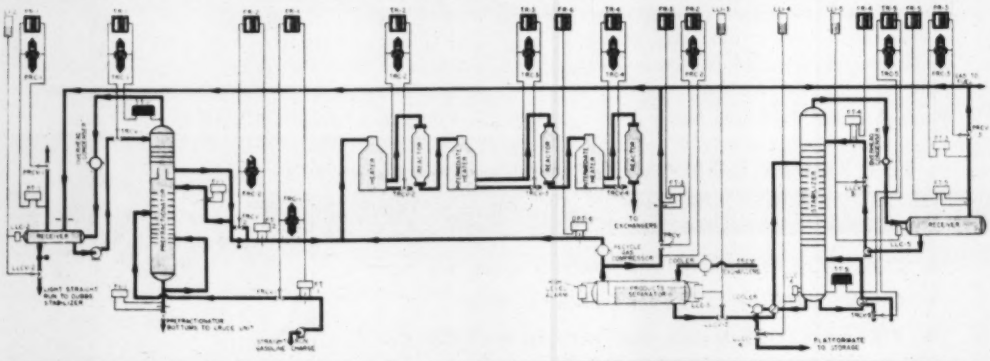
Why did Mid-West PLATFORMING



The Graphic Panel at left, with 16 TRANSET Recorders, also was designed by Universal Oil Products Company, to show all critical variables and control points of the Platforming process at a glance. Operator can check all parts of the process, make any desired changes, right on the board. TRANSET Recorders shown connect to TRI-ACT Controllers on rear of the board, connected in turn to field mounted Taylor Transmitters.

* * *

The drawing below shows the schematic flow diagram and instrumentation of the Platforming process, indicating the wide use of Taylor transmitters, controllers and recorders for maximum efficiency.



Refineries put under TAYLOR TRANSET* CONTROL?

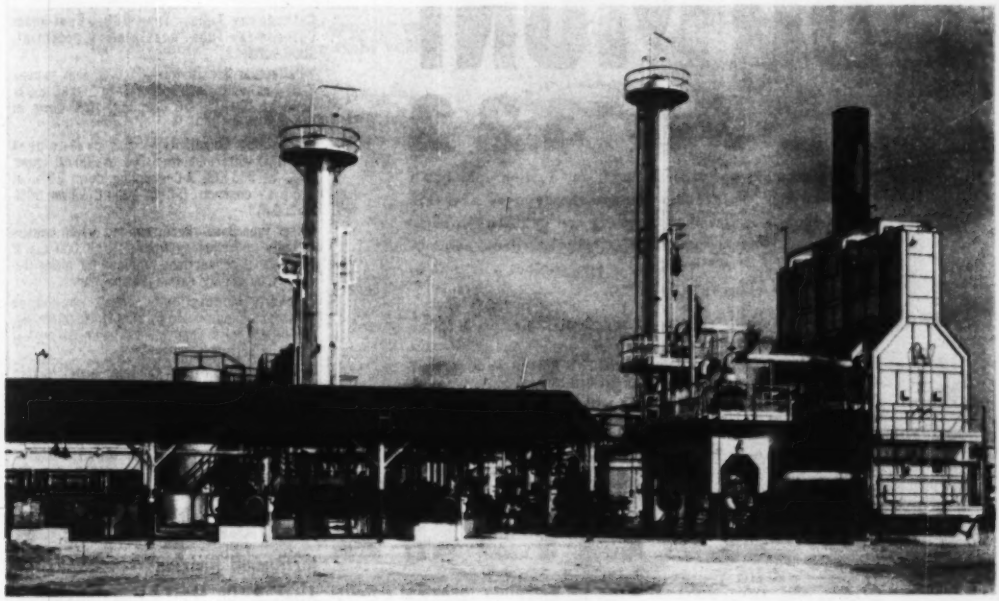
Mid-West Refineries, Inc. at Alma, Michigan, just looked at the performance of Taylor Controls they've used before. Then it was only natural to choose Taylor's exceptionally accurate new three-part TRANSET Control System for their new Platforming process, designed by Universal Oil Products Company and built by Procon, Incorporated. In fact, during their remodeling procedure, they replaced conventional controls on their topping unit with TRANSAIRE* Transmitters, TRI-ACT* Controllers and TRANSET* Recorders — the components of the Transet System.

"With TRANSET Control" says Vice President Everett E. Thompson, "we are having no trouble, for instance, in holding the Platformer transfer temperature at the desired figure. This is important, because of the effect of temperature on octane."

"The Platforming process under TRANSET Control has done an almost unbelievable job; we are able to turn out 90 to 95 octane gasoline, with 90% to 95% liquid yield from straight run," states R. J. Oosdyke, Vice President in Charge of Sales, "and this yield of top quality product puts Mid-West's White Rose gasoline in an extremely favorable competitive position."

This is just a single example of how Taylor's new TRANSET Control system is helping refiners get top quality product at minimum operating cost. Why not talk it over with your Taylor Field Engineer! Or write for **Bulletin 98097.** Taylor Instrument Companies, Rochester, N. Y., and Toronto, Canada. *Instruments for indicating, recording and controlling temperature, pressure, flow, liquid level, speed, density, load and humidity.*

*Reg. Trade-Mark



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A general-purpose DUAL-beam oscillograph to fit your needs technically and financially

the DU MONT TYPE 322

Not just another specialized dual-beam oscillograph, but a brand-new type designed for general development work but rugged enough for production testing and industrial applications as well. Compactness, lightweight, ruggedness and versatility mark the Du Mont Type 322 as another milestone in cathode-ray oscillography.

FEATURES **All the well-known features of the 304-H, and...**

Thoroughly field-tested.

Individual and common time bases with driven or recurrent sweeps and sweep expansion on all sweeps.

Conventional single-ended input with stepped and vernier attenuators, or balanced input with no attenuation, on both Y-axes.

Concentric controls for easy-to-operate, compact control panel.

High-gain D-C amplifiers on both channels.

Amplitude calibration on either channel on both axes.

Illuminated scale with dimmer control.

SPECIFICATIONS

Cathode-ray Tube — Type 5SP — Dual-beam Cathode-ray Tube. Accelerating potential, 3000 volts.

Y-Deflection Sensitivity — 0.028 peak-to-peak (0.01 rms) volts/inch from D-C to 300 KC (50% down at 300 KC); A-C coupling, 10% down at 5 c.p.s.

X-Deflection Sensitivity — 0.3 peak-to-peak (0.1 rms) volts/inch from D-C to 300 KC (down 50% at 300 KC); A-C coupling down 10% at 5 c.p.s.; common, D-C to 200 KC (down 50% at 200 KC).

Linear Time Base—Recurrent and driven sweeps variable in frequency from 2 to 30,000 c.p.s. Front panel connections provided for lower frequency by adding external capacitance.

Intensity Modulation — Input impedance 0.2 megohm, paralleled by 80 $\mu\mu$f. Negative signal of 15 volts peak blanks beam at normal intensity settings.

Beam Control Switch — On front panel to turn beams on or off independently or simultaneously.

Calibrator — Regulated potentials of 50 millivolts and 1 volt peak-to-peak squarewave at power line frequency available at front panel binding posts.

Power Source — 115/230 volts — 50-400 c.p.s. — 225 watts.

Dimensions — Height 15¾", width 12½", depth 22⅞", weight 75 lbs.

$835.00

Write for complete technical details:

Instrument Division
Allen B. Du Mont Laboratories, Inc.
1500 Main Avenue, Clifton, N. J.

Here's the Only 300 Lb. Steel Valve Which Gives You

All These Features

Compare it — feature by feature — with any other cast steel valve you can buy. Not only is it outstanding for metal quality, in the famous Lunkenheimer tradition, but it includes *all* these advanced design features:

1. Backseating surfaces that let you repack while the valve is wide open and under pressure.
2. A smooth, straight-through waterway and full-rising disc to permit even flow and cut turbulence.
3. Swing-down eyebolts that can't become detached — and a convenient shelf that holds the gland flange up, out of the way, during maintenance.
4. Flexible tee-head stem connection that permits the disc to adjust to its seat without binding.
5. Trim combinations for specific applications to assure the **right** valve for the job.
6. Modern end-seated seat rings that seal perfectly against the body to guard against corrosion and leakage.

WRITE FOR "Lunkenheimer Cast Steels," a useful booklet which explains valve metals, helps you match the valve to its job. The Lunkenheimer Co., Box 360E Cincinnati 14, Ohio.

STEEL • IRON • BRONZE

LUNKENHEIMER

THE ONE *Great* NAME IN VALVES

L-951-2

AVAILABLE NOW—196 pages of Valuable Tool Steel Information

A new Tool Steel Handbook—one of the most comprehensive treatises of its kind ever offered by a tool steel producer—has just been published by Allegheny Ludlum. In addition to a relatively complete picture of Allegheny Ludlum Tool Steels, their properties, applications and the forms in which they are available, this 196-page case-bound book presents an extensive discussion of heat treating and handling techniques as well as a complete set of weight tables and other useful reference material.

Your copy of the Tool Steel Handbook will be sent—*without charge*—upon request. Our only stipulation: please make your request upon your company letterhead. • Write Allegheny Ludlum Steel Corporation, Oliver Bldg., Pittsburgh 22, Pa.

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Remember this also
America must have more Scrap to make more Steel!
Get in the Scrap Now!

For complete **MODERN** Tooling, call
Allegheny Ludlum

AL
FINE TOOL STEELS SINCE 1854

Associated Architects: Mayer & Whittlesey • Skidmore, Owings and Merrill
Consulting Engineers: Jaros, Baum & Bolles
Heating Contractor: J. L. Murphy, Inc.

Manhattan House

—with 552 modern, carefully planned apartments overlooking an entire block of 48th and 3rd Ave., New York City. Comfort and fuel savings obtained here, year after year, will yield a handsome return on the investment in POWERS control.

POWERS®

ZONE TEMPERATURE CONTROL

In this Outstanding Apartment Building
Assures Comfort, Dependability, Lowest Maintenance Cost

Temperature of hot water supply to convectors in this modern building is controlled by a Powers **MASTROL** System.

How It Operates—A Powers Master Thermostat with its sensitive bulb in a special housing for sun-wind effect and outdoor temperature is located on outside wall of zone being controlled. It operates in conjunction with 4 Room Thermostats on the 4th, 9th, 14th and 19th floors of each zone through Averaging Relays to establish the control point for Series 100 Sub-Master Controllers. A manually operated switch on the main control panel is provided to raise or lower the control point when desired.

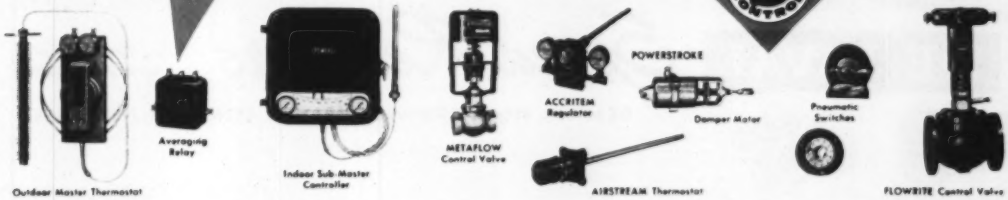
A program clock automatically reverts the controls to night operation during which period the outdoor Master Thermostat readjusts Series 100 Sub-Master Controller to a lower control point than used during day operation. Other types of Powers controls regulate various fans supplying heating and ventilating to other spaces in the building.

Type D Room Thermostat

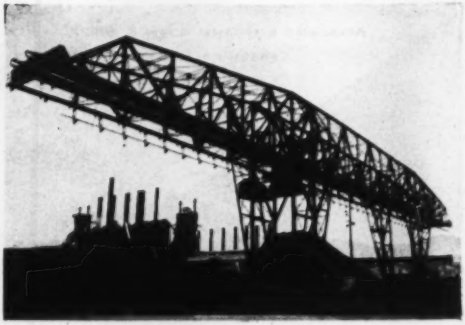
Experience gained by Powers in all types of prominent buildings will be helpful to you. When problems of temperature and humidity arise, contact our nearest office.
THE POWERS REGULATOR COMPANY, Skokie, Ill.

(a77)

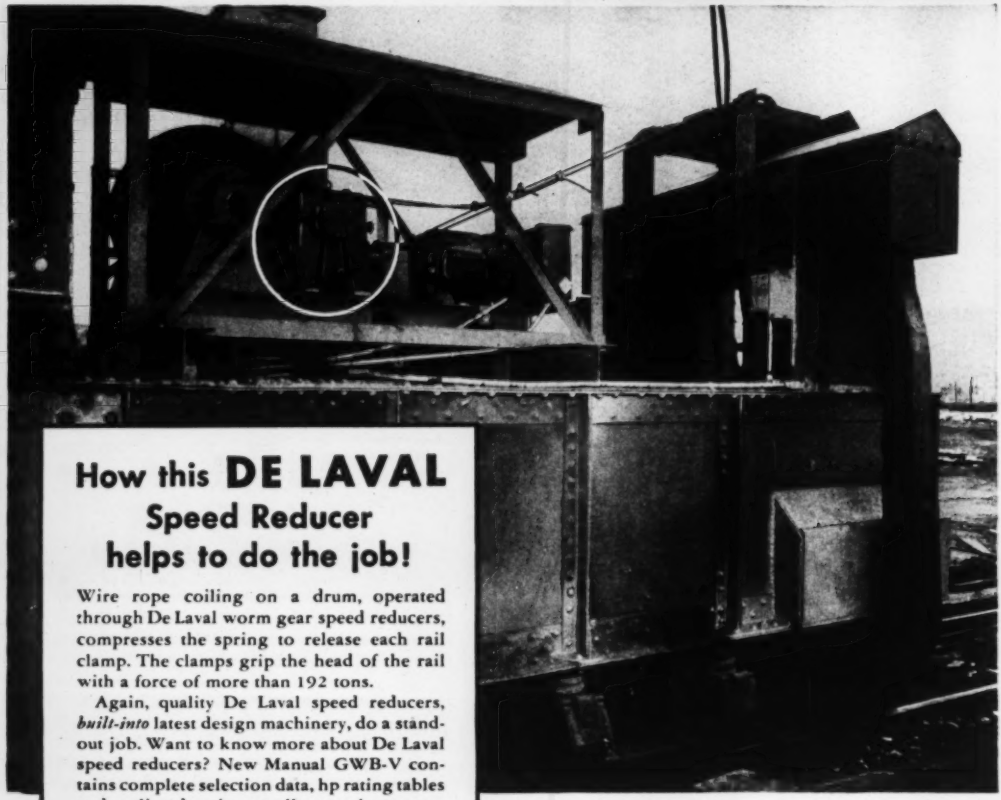
OVER SIXTY YEARS OF AUTOMATIC TEMPERATURE AND HUMIDITY CONTROL — OFFICES IN OVER 50 CITIES



No Free Ride Today!



Wind whistling past a 1,800-foot ore bridge runway occasionally gave this big cable-operated bridge a free ride! To prevent this, a set of spring-loaded rail clamps was installed on the legs of the bridge, thus anchoring it securely.



How this DE LAVAL Speed Reducer helps to do the job!

Wire rope coiling on a drum, operated through De Laval worm gear speed reducers, compresses the spring to release each rail clamp. The clamps grip the head of the rail with a force of more than 192 tons.

Again, quality De Laval speed reducers, *built-into* latest design machinery, do a stand-out job. Want to know more about De Laval speed reducers? New Manual GWB-V contains complete selection data, hp rating tables and outline drawings... all set up in easy-to-use form. Write for your copy today.

DE LAVAL *Speed Reducers*

BUILT TO BE BUILT-INTO A QUALITY PRODUCT

DE LAVAL STEAM TURBINE COMPANY • TRENTON 2, NEW JERSEY

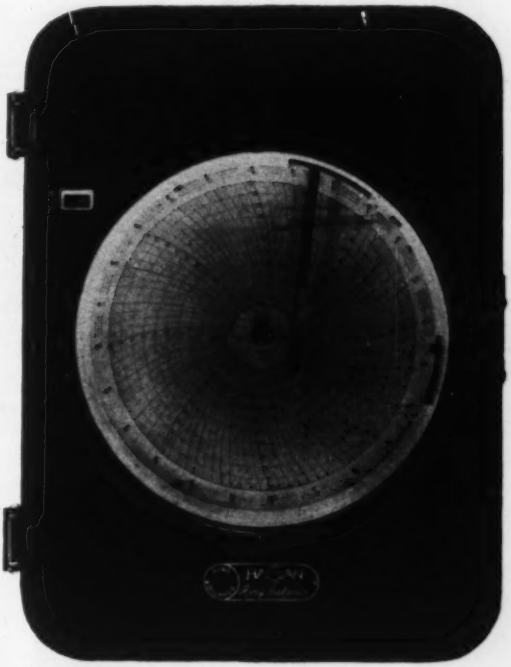
DL108R

use dependable HAGAN

Ring Balance Flow Meters

to measure flow of

water–gas–
steam–oil–
air–other fluids



There are many reasons why you get dependable records when you use Hagan Ring Balance Flow Meters.

These include the unique ring torque resistance system which not only makes it possible to meter low flows reliably, but also provides an integral and convenient means for altering the meter capacity to any value over a 3½ to 1 range. Range changing is further simplified by a dead weight method of calibration. Other features include:

- No stuffing boxes
- Adjustable full scale range
- High sensitivity at low flow rates
- Mercury level not critical

Dependable pressure and temperature compensation (either or both) can be furnished with all Hagan Ring Balance Flow Meters.

An economical feature of all Hagan Ring Balance Meters is that maintenance costs are low. For other information on how versatile Hagan Ring Balance Flow Meters will answer your metering problems, clip the coupon, or write.

HAGAN CORPORATION

HAGAN BUILDING

PITTSBURGH 30, PA.

Ring Balance Flow and Pressure Instruments
ThrusTorq Force Measuring Devices
Boiler Combustion Control Systems
Metallurgical Furnace Control Systems

Hagan Corporation
Hagan Building
Pittsburgh 30, Pennsylvania

Please send me further information on Hagan Ring Balance Meters.

I am particularly interested in.....

.....

NAME.....

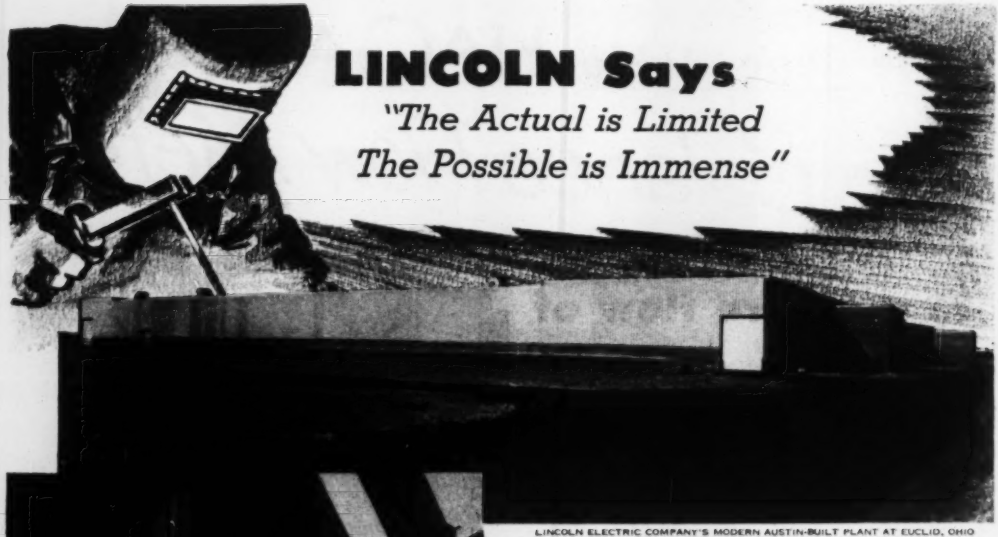
POSITION.....

COMPANY.....

STREET AND NUMBER.....

CITY..... ZONE ... STATE.....

ME-4



LINCOLN Says

"The Actual is Limited
The Possible is Immense"

LINCOLN ELECTRIC COMPANY'S MODERN AUSTIN-BUILT PLANT AT EUCLID, OHIO

We Agree - Here's Why

Erie City Iron Works is proud to have Erie City Boilers and Stokers installed in Lincoln Electric Company's modern Austin-built plant at Euclid, Ohio.

As the oldest boiler builder in America, we well remember when the "Actual" in the Lincoln motto seemed to us to be "limited" by the skill of the riveter. Today, thanks to the great advance in welding science, we find "Possibilities Immense." Today, Lincoln welded seams are routine in all Erie City Boilers, and former potential trouble points are transformed into the strongest parts of the boiler shell.

There's a modern Erie City Boiler to meet any steam demand. Outline your requirements.

BOILER and STOKER DATA

BOILERS	2-ERIE CITY 2-DRUM (550 hp.)
CAPACITY	38,000 pounds STEAM per hour
DESIGN PRESSURE	160 lbs.
FIRING EQUIPMENT	2-ERIE CITY DUMPING GRATE SPREADER STOKERS
FUEL	OHIO BITUMINOUS

ERIE CITY
112 Years in Steam Generation

ERIE CITY IRON WORKS • *Erie, Pa.*

STEAM GENERATORS • SUPERHEATERS • ECONOMIZERS • AIR PREHEATERS
UNDERFEED AND SPREADER STOKERS • PULVERIZERS

LADISH

Controlled Quality

PIPE FITTINGS

reduce piping assembly time

Makeup goes smoother... with less chance for delay... on those piping systems where Ladish fittings are installed. Ladish Controlled Quality makes the difference. By exacting controls over materials and manufacturing processes... Controlled Quality assures uniform weldability through metallurgical integrity, fast assembly through dimensional accuracy and provides a real assurance of ultimate operating economy and complete dependability... reasons why it pays to specify LADISH.

THE COMPLETE *Controlled Quality* FITTINGS LINE
PRODUCED UNDER ONE ROOF...ONE RESPONSIBILITY

LADISH CO.

CUDAHY, WISCONSIN
MILWAUKEE SUBURB

District Offices: New York • Buffalo • Pittsburgh • Philadelphia • Cleveland • Chicago • St. Paul
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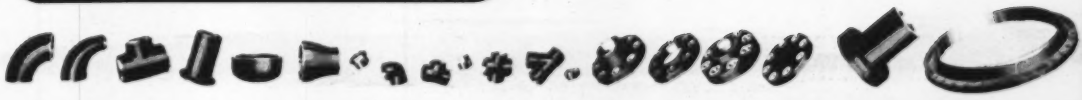
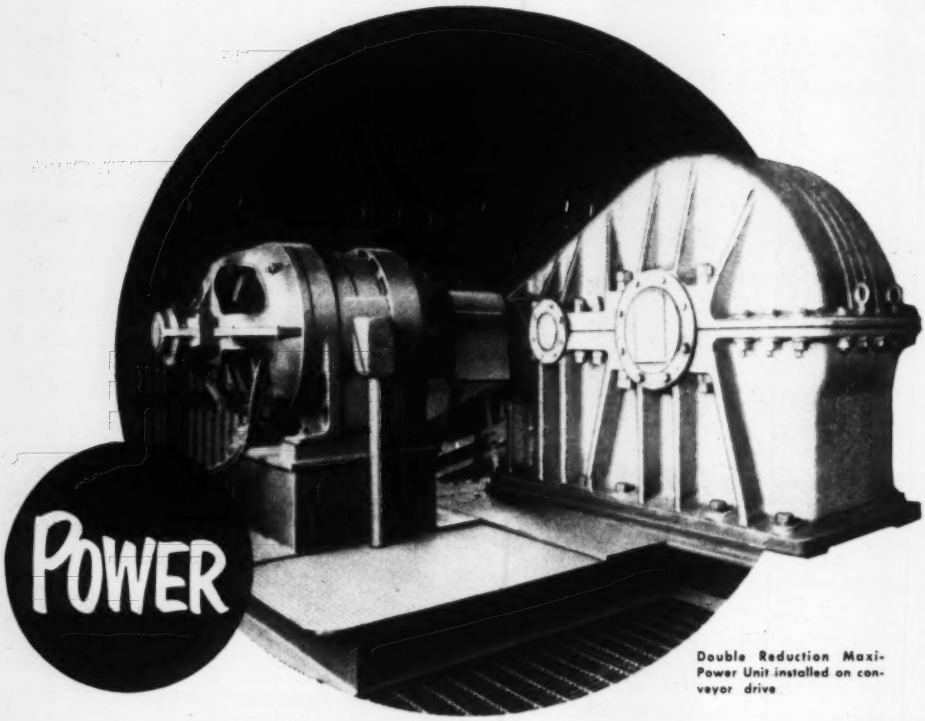
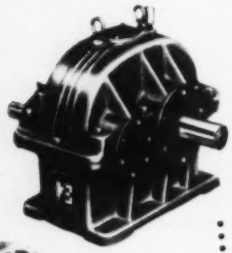


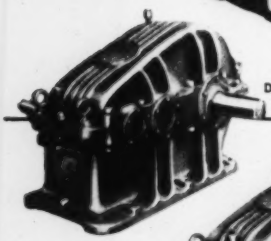


Double Reduction Maxi-Power Unit installed on conveyor drive

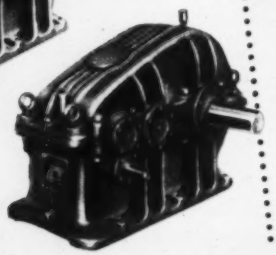
in minimum space with *Maxi-Power* parallel shaft drives



SINGLE REDUCTION



DOUBLE REDUCTION



TRIPLE REDUCTION

For heavy-duty applications, here is a drive that offers the maximum in sturdy, reliable service.

Precision generated helical gearing with uniform load distribution across the entire face means improved performance — permits maximum load-carrying capacity in minimum space.

Maxi-Power Drives are available in single, double and triple reductions in ratios from 2.08 to 1 up to 360 to 1 — capacities up to 1,550 h.p.

Mail the coupon for engineering bulletin on Maxi-Power Drives or call the Foote Bros. Representative near you.

FOOTE BROS. GEAR AND MACHINE CORPORATION
Dept. Q. 4545 S. Western Blvd. • Chicago 9, Illinois

FOOTE BROS.

Better Power Transmission Through Better Gears

Foote Bros. Gear and Machine Corporation
Dept. Q. 4545 S. Western Blvd., Chicago 9, Ill.

Please send Bulletin MPB containing full information on Maxi-Power Drives.

Name .....

Company .....

Position .....

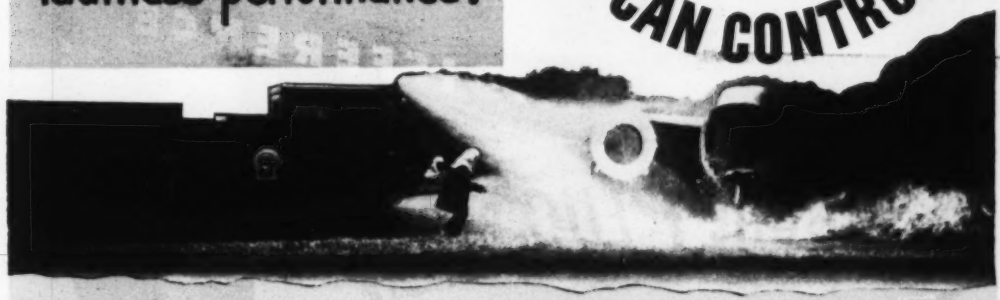
Address .....

City ..... *State* .....

Always specify

TDA BRAKES

when lives depend on faultless performance!



Speed and power in a vehicle call for positive stopping ability—and that means TDA Brakes! The Air Forces crash car shown here is a fine example of a military vehicle built for emergency use at an instant's notice—and providing perfect maneuverability and control. When vehicle performance can mean the difference between a minor accident and a major tragedy—between life and death—our armed forces don't take chances on equipment that might not get the job done. They insist on vehicles that are tested and proved in every respect. That's why American LaFrance, builders of the crash car shown on this page, installed the TDA "H" Series hydraulic brake illustrated at left. There are more TDA Brakes in actual use on heavy-duty commercial vehicles than any other make. More than forty years of brake engineering experience have made TDA America's greatest name in brakes!

TIMKEN *Detroit* BRAKES

TDA BRAKE DIVISION

THE TIMKEN DETROIT AXLE COMPANY

ASHTABULA OHIO

Accepted TDA Standard

TRADE MARK REGISTERED

WHATEVER YOUR BRAKING PROBLEM—TAKE IT TO TDA!

TDA BRAKE DIVISION—DEPT. 4C, ASHTABULA, OHIO

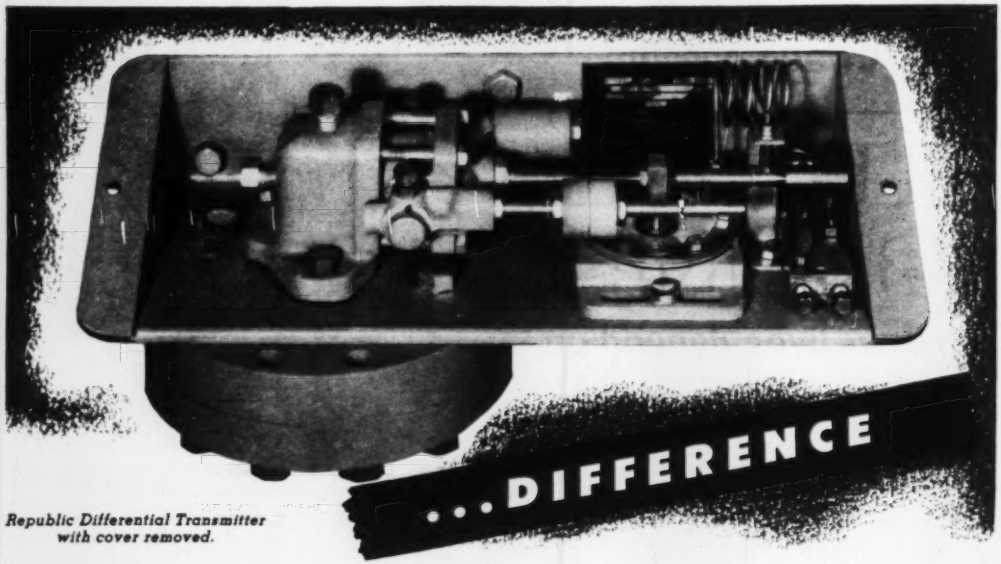
Please mail brake information on these applications:

NAME_____

COMPANY_____

ADDRESS_____

CITY_____ STATE_____



Republic Differential Transmitter with cover removed.

Spells *PLUS* PERFORMANCE

The Republic Pneumatic Transmitter combines machine ruggedness with instrument precision to provide matchless performance in measuring flow, level, pressure or density of a wide variety fluids. By any or all of the following points, the Republic challenges comparison:

ACCURACY of the Republic force-balance principle is higher than can be consistently secured and maintained with any other method. 1/2 of 1% guaranteed.

TEMPERATURE variations of ambient atmosphere have negligible effect on the accuracy of the Republic transmitter.

CHANGES IN AIR SUPPLY PRESSURE do not affect the accuracy of a Republic transmitter to any significant extent. A 5 psi change produces an error of less than 1/10%.

CHANGES IN LINE PRESSURE—Republic differential transmitters are not affected by variations in line pressure. A patented and exclusive simple adjustment assures this protection.

SENSITIVITY—Due to the negligible motions required for complete operation of all parts, for a full scale change, no appreciable hysteresis results from reversal of direction of measurement change.

VIBRATION of any normal frequency has no effect on the Republic transmitter.

LEVELING—Since all parts are balanced, and no liquid is used for calibration, Republic transmitters need not be leveled exactly, and may be adjusted for installation in any position.

FOR TWELVE YEARS Republic Pneumatic Transmitters have delivered unmatched performance in every type of installation. Complete details of design and operation, plus numerous application suggestions are combined in Data Book, 1002. Send for your copy, today.

REPUBLIC FLOW METERS CO.

2240 Diversey Parkway, Chicago 47, Illinois

Seals OUT TROUBLE!

SKF Red Seal bearings

1 Seal is stable DuPont Fairprene, unaffected by petroleum-base lubricants, normal operating temperatures, or ageing.

2 Seal, extending below steel retaining ring, forms a flexible lip which lightly touches a smooth, uniform chamfer of the inner ring. This exclusive design provides effective sealing with extremely light contact, hence low friction.

3 Circular-formed ribs around the retaining rings provide great rigidity. Thus, seal contact can be light, yet certain under all operating conditions.

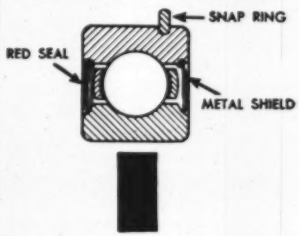
4 Retaining ring is staked securely during manufacture—stays put for the life of the bearing.

5 Lubricated at the factory.

PROVED IN SERVICE---

Machine designers know they are competitively priced—all are interchangeable with conventional non-sealed bearings. Because SKF pioneered in the sealed-bearing field—the first to incorporate effective seals within the standard SAE width bearing—designers have come to depend on this store of engineering knowledge built into each Red Seal Bearing. They know, too, that the team-work of SKF field-engineers and design-engineers at SKF's headquarters are theirs for the asking. **SKF INDUSTRIES, INC.,** PHILADELPHIA 32, PA.—*manufacturers of* SKF *and* HESS-BRIGHT *bearings.* 7X8-A

RED SEALS ARE ALSO AVAILABLE WITH SNAP RINGS AND METAL SHIELDS—ANY COMBINATION OF THESE THREE FEATURES ARE AVAILABLE



SKF
BALL AND ROLLER BEARINGS

IN EVERY INDUSTRY, SKF Puts The Right Bearing In The Right Place

As the result of several years of investigation and research, Lord engineers have developed successful techniques for bonding silicone to metal. This extends the advantages of bonded rubber into the wider temperature range from —100° to +500°F.

A number of Lord Vibration-Control Mountings are available with silicone elastomers, and new designs are being engineered to take full advantage of the properties of this new material.

You can solve many product problems with Lord bonded-silicone parts which are used to isolate vibration and reduce operating noise, and protect parts from excessive stresses.

The easiest way to get the full story of the advantages of LORD BONDED SILICONES is to write or call . . .

BURBANK, CALIFORNIA
Joe B. Hartley
George E. Behlmer
233 South Third Street
ROckwell 9-2151
CHarleston 6-7481

CHICAGO 11, ILLINOIS
Robert T. Daily
Kenneth L. Hanson
Perry C. Goodspeed, Jr.
520 N. Michigan Ave.
MIchigan 2-6010

DALLAS, TEXAS
Bruce O. Todd
1613 Tower Petroleum Building
PRospect 7996

DAYTON 2, OHIO
W. Webster Dalton
238 Lafayette Street
MIchigan 8871

DETROIT 2, MICHIGAN
Everett C. Vallin
7310 Woodward Ave.
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NEW YORK 16, NEW YORK
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280 Madison Avenue
MUrray Hill 5-4477

PHILADELPHIA 7, PENNSYLVANIA
George P. Harrington
725 Widener Building
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ERIE, PENNSYLVANIA
Paul E. Dailey
Harry C. Sapper
1635 West 12th Street
2-2296

LORD MANUFACTURING COMPANY • ERIE, PA.

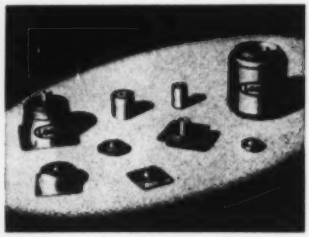
LORD — BONDED RUBBER

HEADQUARTERS FOR
VIBRATION CONTROL MOUNTINGS
. . . BONDED RUBBER PARTS

Silicones Bonded to Metal Improve Product Operation at Extremes of Temperature

The new field of organosilicon chemistry has produced silicone rubber which is thermally stable. Translated in terms of work for practical application in industry, silicone rubber maintains resiliency and provides maximum isolation of shock and vibration at such extreme temperatures as —100°F and +500°F.

Going a step farther silicone rubber molded into useful forms opens up a wide field of value to the designer of industrial products. For example, the bonded-silicone vibration control mountings and bonded-silicone parts produced by the Lord Manufacturing Company of Erie, Pa. Especially is this true in the vitally important field of modern aviation, both military and commercial.



Lord Bonded-Silicones have excellent dielectric characteristics and their chemical stability permits use under most atmospheric and chemical conditions with no danger of decomposition.

Heretofore the highest efficiency of other elastomers was limited by a temperature range of —80°F and +170°F. The hardening of ordinary rubbers at the above low temperature and their deterioration at the high, posed a problem for Lord Engineers which finally found its solution in the application of silicone compounds. Lord Bonded-Silicones are now in service on aircraft nacelle mounted equipment and airborne electronic equipment as vibration isolation mountings. Lord Bonded-Silicone parts are also used as turbojet bearing seals, commutator spring bumper pads, on fire detectors and on diesel equipment operating at extremes of temperature. The high resistance to moisture of bonded-silicones suggests many practical uses as yet in the experimental stage.

Specialized Elastic Material Seals Vapor-Tight Valve

Among the many manufacturers who have improved the performance of their products through the use of specialized elastic compounds is Kerotest Manufacturing Company, Pittsburgh, Pa. Their recently announced General Twin-Seal Valves employ a tapered plug between two elastic-surfaced "slips". These slips are made of corrosion resistant metal with specialized elastic material permanently bonded to the surfaces which come into contact with seats of the valve. The first full turn of the control wheel raises the tapered plug and withdraws the slips from their seats until approximately .040" clearance results. The next quarter turn of the wheel revolves both tapered plug and slips to line up the plug ports with those of the valve body.

During the early stages of development and test of these new valves, considerable difficulty was encountered in finding a type of elastic coating for the slips which would withstand attack by salt water, gas, and highly-volatile hydro-carbons; and which would also retain its resiliency under repeated applications of pressure. At this point, the problem was placed with Lord Manufacturing Company, Erie, Pa.

After careful study, Lord compound #E-3425 was recommended. This compound has a Buna-N Base, and is particularly resistant to abrasive wear and swelling. Furthermore, #E-3425 lends itself well to the formation of a high-strength bond with the metal part of the slip.

Performance records have been highly satisfactory since Lord compound #E-3425 was adopted as standard for the resilient surfacing of all Kerotest valve slips. As the result of this intelligent analysis Kerotest General Twin-Seal Valves are furnishing the petroleum industry, marine industry, and other industrial valve users with a type of service previously unavailable in plug valves.

KEROTEST MFG. CO. DID . . .

Profitably!

The manufacturer of Kerotest General Twin-Seal Valves needed bonded-rubber seals which would not peel or disintegrate in contact with volatile petroleum products. The problem was placed with Lord. The answer was found immediately in a specialized compound which Lord engineers had already developed for another valve seal requirement . . . the toughest, longest lasting, precision contoured seal yet known.

Your product may be improved by using Lord bonded-rubber parts . . . the easiest way to control vibration and reduce operating noise. You can find dependable, profitable answers to help you among the many Lord case histories of successful bonded-rubber applications.

For immediate attention to your problem call or write

BURBANK, CALIFORNIA
Joe B. Hartley
George E. Behlmer
233 South Third Street
ROckwell 9-2151
CHarleston 6-7481

CHICAGO 11, ILLINOIS
Robert T. Daily
Kenneth L. Hanson
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George P. Harrington
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LOcust 4-0147

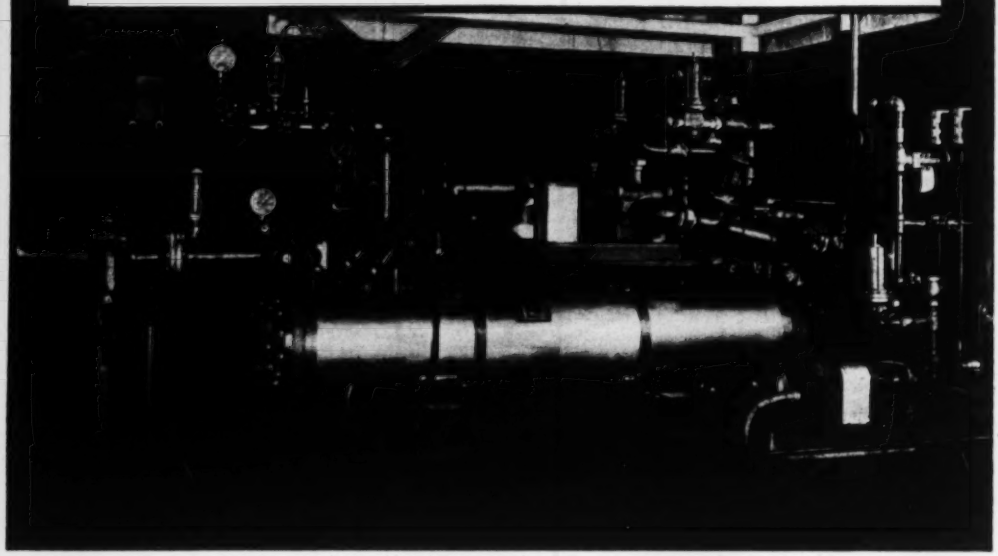
ERIE, PENNSYLVANIA
Paul E. Dailey
Harry C. Sapper
1635 West 12th Street
2-2296

LORD MANUFACTURING COMPANY • ERIE, PA.

LORD BONDED RUBBER

HEADQUARTERS FOR
VIBRATION CONTROL MOUNTINGS
. . . BONDED RUBBER PARTS

2 separate ENCO Fuel Oil Units Meet Plant Needs



Here is a typical Enco two-unit installation which handles fuel oil pumping and heating requirements in the plant of a building materials manufacturer.

Fuel Oil Pumping and Heating Unit, built with two pumps and two heaters, is designed for continuous plant load service. Capacity is 11 gpm Bunker C fuel oil with one pump or one heater at 300 psig pressure with a temperature rise from 90F to 230F.

Light Oil Pumping Unit for cold start-up service. Capacity is 3 gpm #2 oil at 300 psig pressure.

Enco pump sets are designed to give you easier control and longer maintenance-free operation. They are simple and economical to install. All you need do is to connect to station piping and run. Before shipping, every Enco Fuel Oil Pumping and Heating Unit is completely tested under high pressures. For complete details on wide-range line, write for Bulletin O B-37.

Only ENCO offers all ten plus features

1. Completely Automatic Operation is assured by automatic temperature and pressure regulation valves.

2. Coordinated Design Saves Space. All equipment essential to the preparation of fuel oil for combustion is contained in one compact unit.

3. Individually Designed to meet the specific needs of the particular power plant in accordance with its exact operating requirements.

4. All Parts Visible and Accessible for easy operation, maintenance and repair.

5. Pumps and Heaters are interconnected to provide maximum flexibility of operation.

6. Safety Valves protect individual parts where required.

7. Easier Maintenance — Less Service-Time for Cleaning because straight tube, multi-pass heaters with removable heads are used.

8. Pumps Operate at Moderate Speed. Heaters designed to give the correct viscosity and velocity without fouling.

9. Smoother Flow of Clean Fuel to Furnace. Air chamber for each piston pump prevents pulsations—pressure regulator for rotary pumps. Twin type strainers provided to keep atomizer tips from clogging.

10. Cleaner Boiler Room . . . all overflows connected to a common outlet, flanged drip pan catches oil drip.

EC 495

THE ENGINEER COMPANY

75 WEST STREET, NEW YORK 6, N. Y.

IN CANADA: F. J. RASKIN, LTD., 4220 IBERVILLE ST., MONTREAL 34, P. Q.

SILICONE "O" RINGS

Good News For Today's Designer

Results from a recent survey show the successful use of a variety of silicone compounds in seal applications never attempted before with a resilient material because of temperature limitations. According to Linear, Incorporated, of Philadelphia, Pa., a principal manufacturer of "O" Rings, one group of silicone compounds have been designed for general use at temperatures ranging from −65° to +500°F. Modifications of the general purpose stocks have produced several compounds with extreme low temperature flexibility. Other types possess a maximum resistance to compression set over a wide temperature range.

Chart Tells The Story

SILICONE RUBBER STOCKS

Linear Style No.	Hardness Shore A Scale	Tensile Strength Min. P.S.I.	Elongation Min. (%)	Temp. Range (°F.)	Compression Set*	Color
ZK-50	50	400	100	−65 to +400	10 to 20	Red
ZA-60	60	400	150	−65 to +400	50 to 70	White
ZM-70	70	500	75	−65 to +400	15 to 25	Gray
ZN-80	80	600	50	−65 to +400	20 to 35	White
ZT-60	60	350	130	+125 to +400	30 to 50	Red
ZD-60	60	350	150	−85 to +400	40 to 60	Red
ZG-45	45	550	250	+125 to +400	40 to 60	Red-Tan
ZJ-60	60	500	70	−65 to +400	20 to 30	Red
ZP-80	80	550	50	−70 to +400	60 to 80	Gray
ZS-80	80	550	50	−70 to +400	25 to 30	Gray
ZU-50	50	600	225	−65 to +400	65 to 75	Neutral

* Method B 22 hours at 300°F.

Notes:

1. *Temperature range values are based on actual experience in the field and the silicone rubber will perform very satisfactorily within these ranges over long periods of time. Intermittent temperatures as high as +500°F. are not harmful in most applications, but will shorten the ultimate life of the rubber.*
2. *All other values were determined at room temperature according to A.S.T.M. procedure. For silicones, room temperature values are retained with relatively little change over a wide temperature range. Therefore, they can be used with some assurance in selecting compounds for specific applications.*

Successful Usage Today

Silicone "O" Ring gaskets have proven to be highly successful as static sealing parts on a wide variety of equipment subject to extreme temperature conditions, oxidation, or to prolonged weathering. Silicone seals are giving outstanding service on certain types of aircraft shut-off valves which control the in-take of hot air from the intermediate stages of jet engine compressors under 500°F. operating conditions. Further investigation indicates the use of silicone "O" Rings on outdoor flood-lights, steam irons, transformers, geophysical equipment and diesel engines.

Research For Tomorrow

Linear Incorporated is continuing its Research Program to develop new silicone seals to meet the increasing demand for elastomers having a wide variety of physical properties. The future indicates that there will be expanding requirements for the many advantages offered by silicone as an outstanding engineering material for sealing purposes.

GASKET SPECIFICATIONS:

- MUST WITHSTAND TEMPERATURE VARIATIONS OF −125°F. to +400°F.
- MUST BE MOISTURE RESISTANT
- MUST WITHSTAND SEVERE THERMAL AND MECHANICAL SHOCK

LINEAR

SILICONE "O" RING GASKETS MEET TOUGH SPECIFICATIONS

LINEAR Silicone "O" Rings help the design engineer solve any number of unusual specifications. The ability to withstand extremes in temperature, for example, is typical of the high flexibility of this seal.

In this application, the need was for a gasket with a flexibility that could resist heat as high as +400°F. or cold as low as −125°F. Complete elimination of moisture, oxidation, thermal and mechanical shock to lens and bulb of the searchlight was an absolute must.

The sales potential of this product has been strengthened with LINEAR Silicone "O" Ring Gaskets. No longer do gaskets deteriorate rapidly, permitting moisture to enter socket . . . no longer do bulbs break because of thermal or mechanical shock . . . no longer is it necessary to replace gaskets whenever a bulb needs replacing. LINEAR "O" Rings keep a tight, moisture-proof seal throughout all extremes of weathering—they do not become gummy or stick at high temperatures.

To lower costs and reduce sealing maintenance, consult LINEAR for all your sealing requirements.

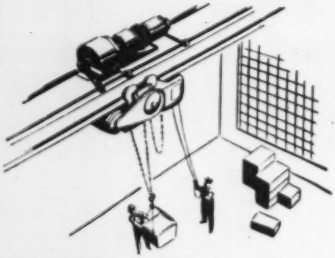
"PERFECTLY ENGINEERED PACKINGS"

LINEAR

LINEAR, Inc., STATE ROAD & LEVICK STREET, PHILADELPHIA 35, PA.

American Blower . . . a time-honored name in air handling

Albuquerque, N.M., has a conveniently located American Blower office to provide you with data and equipment for air handling. You can reach American Blower in Albuquerque by calling 3-2247. In other cities, consult your phone book.



SMOOTH POWER

If you're concerned with power transmission you'll want to know more about our Gŷrol Fluid Drives. They offer three important advantages—smoother acceleration, overload protection and substantial power savings. One company uses Fluid Drive on a crane that picks up ladles of hot metal. Before they were installed, the ladles got a violent swing from the quick start and were hard to control. Since using Fluid Drives they've had no trouble.

B FOR AIR

One of the stiffest tests air handling equipment can get is that imposed by hospital laboratories. Cultures and tests require a sterile atmosphere. Temperature and humidity must often be closely controlled. Recently, a large university hospital selected American Blower ventilating equipment for its new laboratory . . . a fine tribute not only to the quality of American Blower products, but also to the effectiveness of our research and testing methods. Why not put this valuable experience to work for you?

BETTER BURNING

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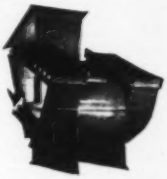

Mechanical Draft Fans

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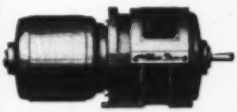

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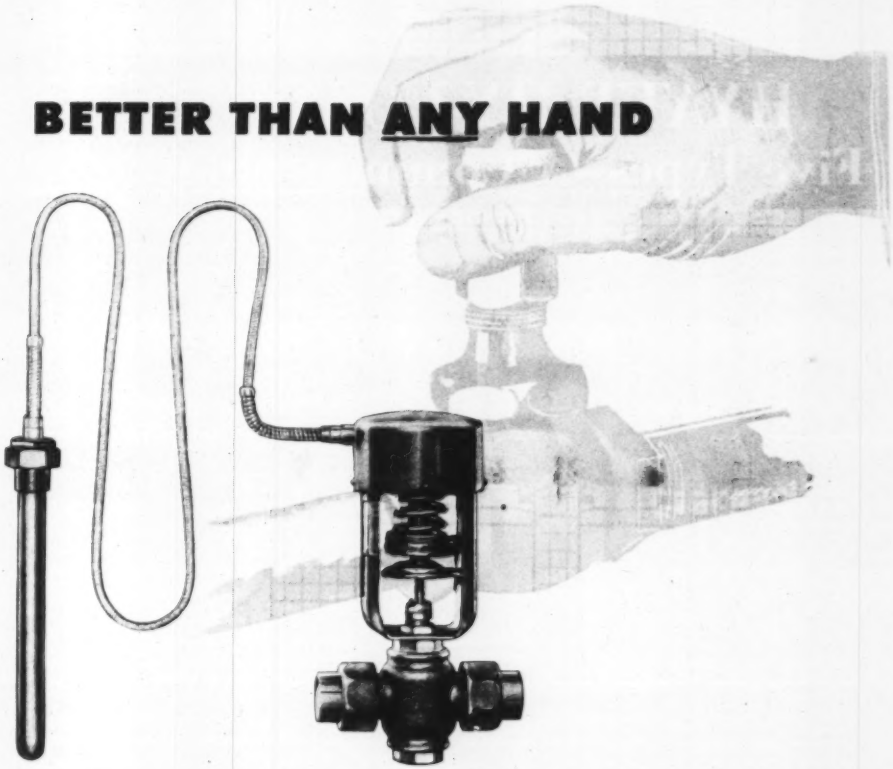

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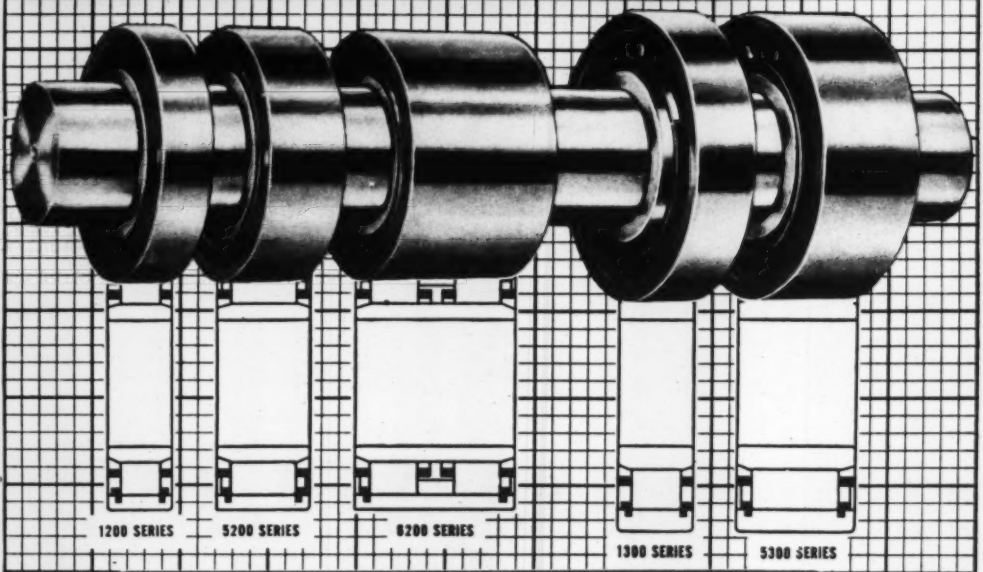

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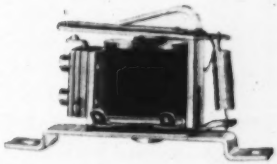

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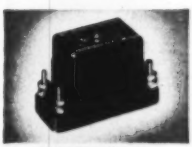

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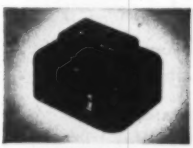

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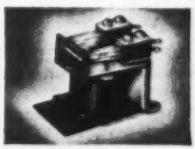
Series 595 D.C.



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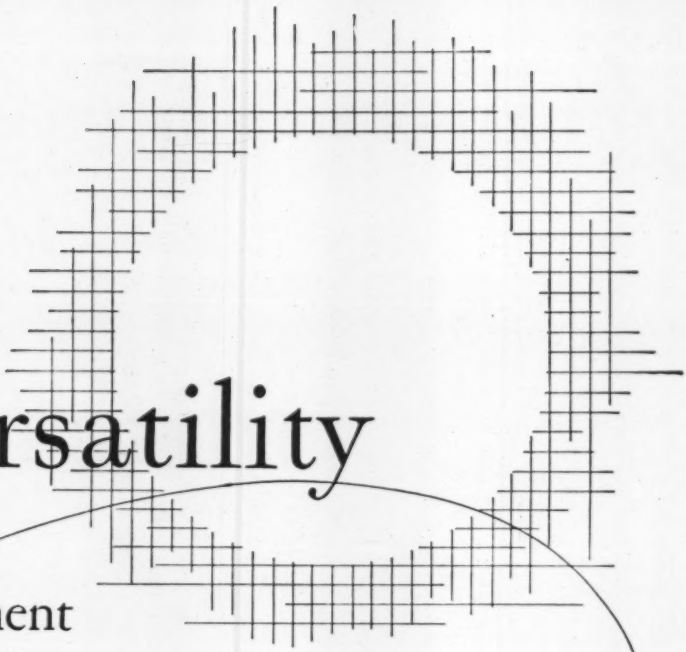

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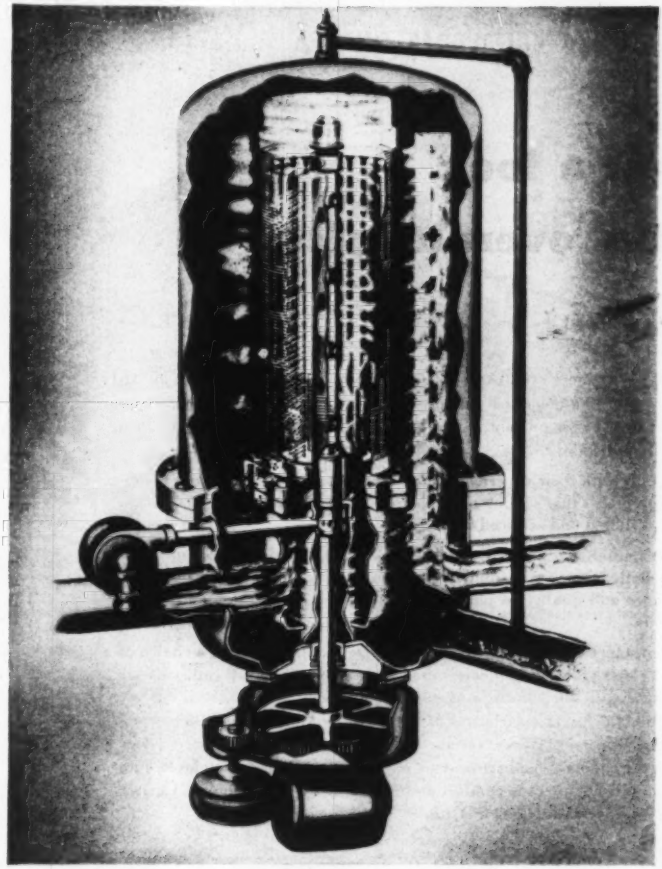

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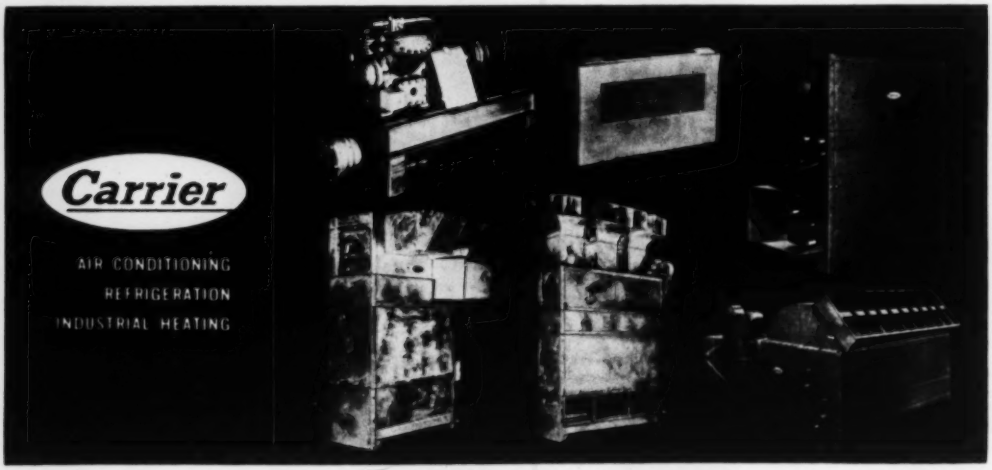

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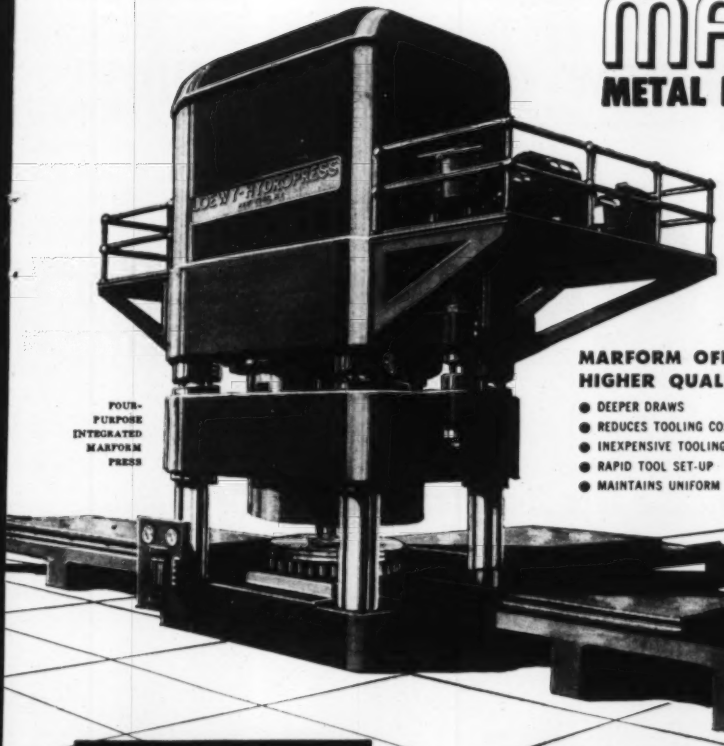

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MECHANICAL ENGINEERING

Published by The American Society of Mechanical Engineers

VOLUME 74 NUMBER 4

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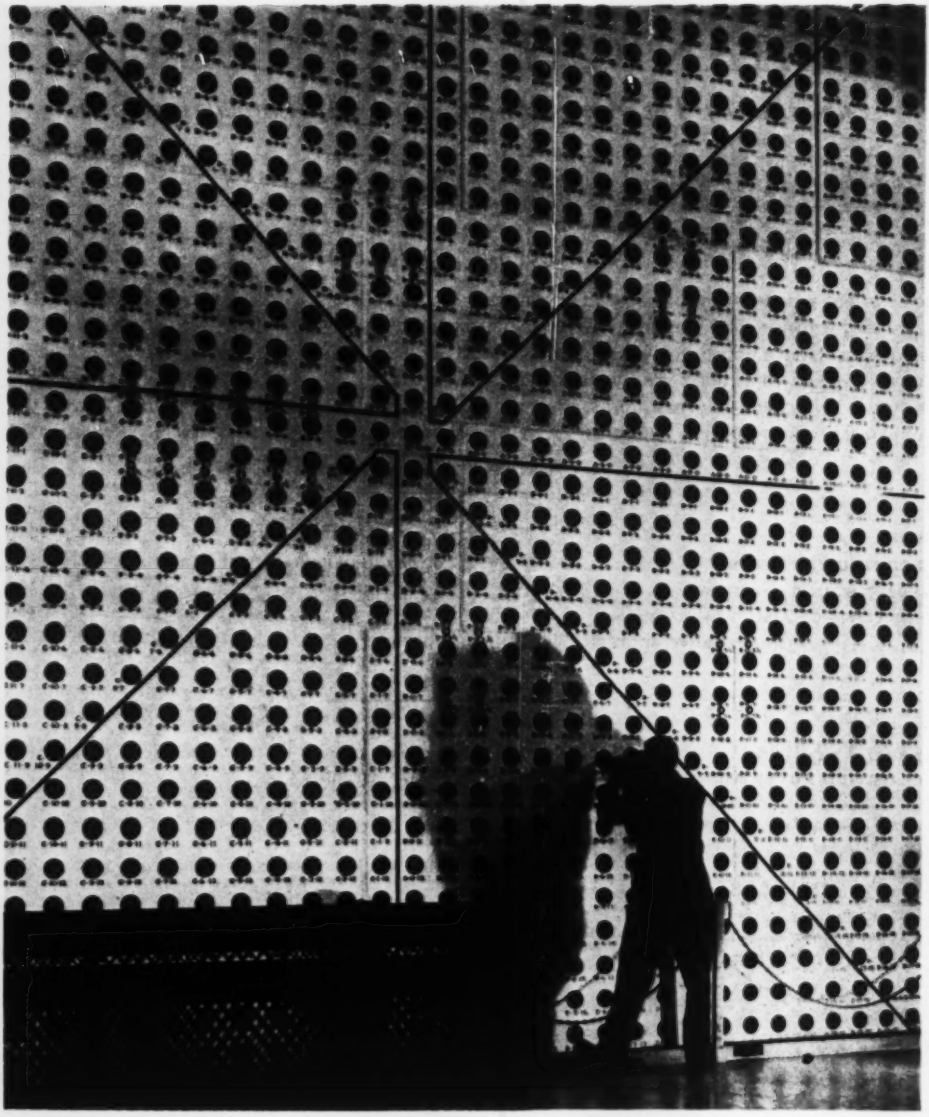

South Face of Low-Power Nuclear Reactor at Brookhaven National Laboratory, Upton, N. Y

(Tons of pure uranium metal are loaded through the holes in this shielding wall of the reactor into the graphite moderator before uranium atoms can fission or split in a chain reaction. The rows of holes are 8 in. apart and represent the arrangement of the uranium metal as it resides in the graphite moderator. The holes can also be used to insert certain types of metals and other substances to be irradiated by neutrons. A technician stands on an elevator enabling him to move to any level of charging holes. He is using a periscope to view the handling of these highly radioactive sources by remote control, by means of grappling tools, and other equipment. *For further details and photos, see pages 324–326 of this issue.**)*

MECHANICAL ENGINEERING

VOLUME 74
No. 4

APRIL
1952

GEORGE A. STETSON, *Editor*

H. W. Dickinson

HENRY Winram Dickinson, who will long be remembered for his contributions to the history of engineering and technology, died on February 21, 1952, at the age of 81. He was born at Ulverston, Lancashire, in 1870, attended the Manchester Grammar School, studied to be a mechanical engineer, and associated himself with the Science Museum in South Kensington, London, in 1895, where he was a member of the staff until his retirement in 1930 after serving for many years as keeper. His books on Fulton, Watt, Boulton, Trevithick, and the steam engine, and his many papers on developments in engineering and technology, won for him an enviable reputation as a scholar, historian, and biographer. He was one of the founders, in 1920, of The Newcomen Society for the Study of the History of Engineering and Technology. From the start of this extraordinary organization until failing health made it necessary for him to relax his efforts, Dr. Dickinson held the post of honorary secretary. At the twenty-fifth anniversary of the foundation of The Newcomen Society, Loughnan St. L. Pendred, former editor of *The Engineer*, referred to Dickinson as the "mainstay, the guide, and the light" of the society, and paid tribute "to the debt the society owed to Dr. Dickinson for the many papers he had contributed, for editing the Transactions, for arranging summer meetings, and for acting as their ambassador to the U. S. A."

Dr. Dickinson possessed a tireless physical and mental energy. He had the characteristics of a scholar, an avid curiosity and boundless enthusiasm for his chosen work, a meticulous regard for detail and accuracy, and a catholicity of interests. He was a modest man who appeared to care little for empty honors and could say with simple sincerity, "Happiness of a man consisteth not in the multitude of his possessions, but in the fewness of his wants." He was a gracious host and lively conversationalist. One recalls his home in Surrey, where he served strawberries of enormous size from his well-kept garden with its flowers, vegetables, and espalier of fruit trees, and the pride he took in displaying the woad he had cultivated—true antiquarian plant, for it was from woad that the early inhabitants of Britain obtained the blue dye with which they covered their bodies. Americans who met him for the first time, expecting from outward appearances to find a naïve and truly Pickwickian character, were immediately captivated by the graciousness of his personal charm, the breadth and depth of his knowledge, and the brilliant quality of his conversation. They could and did forgive his somewhat vague adherence to schedules. On one occasion during a visit to America, the harassed officebearers of American Newcomen were forced to exercise their influence to delay the departure from New York of one of the Central's crack trains because "Dickie," as his British colleagues called him, had not showed up. Just as he was about to board the train his suitcase, with the perversity of all inanimate objects, fell open, spilling personal apparel and toilet articles over the platform. Exasperated porters, conductors, trainmen, stationmasters, and the Newcomen Vice-President for North America, Dr. Charles Penrose, got in each others' way trying to retrieve the elusive contents of the suitcase. Only Dickinson remained calm and unperturbed. For such a man his friends can have no sentiments short of warm affection.

Whether he wrote about steam engines, or such simple things as besoms, wood screws, and drafting instruments, Dickinson presented carefully documented facts gleaned from libraries and shop records and put them together in historical sequence and discriminating perspective. Thus bit by bit he delved into the origins of technology and assembled the essential facts for a comprehensive record of achievement.

In the field of biography Dickinson wrote not only of such well-known figures as Fulton, Watt, Boulton, and Trevithick but he also rescued from possible oblivion men who have been "undeservedly neglected." Typical of these is James White (1762–1825), civil engineer and author of the "New Century of Inventions," about whom Dickinson wrote in a paper delivered scarcely a year ago before the Iron and Steel Institute.

Of the full-length biographies, "James Watt and the Steam Engine," which Dickinson wrote in collaboration with Rhys Jenkins as the Memorial Volume prepared for the Committee of the Watt Centenary Commemoration at Birmingham in 1919, and published in 1927, is the most monumental. This exhaustive piece of biographical research and record was supplemented in 1936 by a smaller volume "James Watt: Craftsman and Engineer." Through these books not only Watt's life and work are made available, but his sketches and documents are preserved, and the influence on his success exerted by his business partner, Matthew Boulton, is brought into focus.

Dickinson's flair for a living story is well illustrated in the exciting biography, "Richard Trevithick: The Engineer and the Man," which was written in collaboration with Arthur Titley, first president of The Newcomen Society, and published, with the financial assistance of Babcock and Wilcox, Limited, in connection with the

centenary of the death of Trevithick. In this volume Captain Richard Trevithick becomes a thoroughly real personality, one of the most romantic and fascinating, as well as unfortunate, of the pioneers of steam engineering, as also does his wife, Jane, caring for him when he was at home, rearing his children, managing at times his accounts and affairs, and hovering in the background of his story as one who must have understood and loved him, and for these reasons alone put up with his exasperating and impetuous ways. Such portraits as Dickinson and Titley have presented in this book raise the work of biographical research into the realm of superb character delineation.

Great as were Dickinson's achievements as a scholar, historian, biographer, and museum curator in the fields of engineering and technology, his influence as "the mainstay, the guide, and the light" of The Newcomen Society will be loudly acclaimed by many. This Society was named for Thomas Newcomen, who was, according to Arthur Titley, its first president, "the man who first drove a piston through the agency of steam." Newcomen's "atmospheric" engine was used to pump water from mines. James Watt, the instrument maker of Glasgow, in repairing a model of Newcomen's engine, conceived the idea of fitting to it a separate condenser and thus he became the "inventor" of the modern steam engine. In a presidential address to The Newcomen Society in 1949, Dr. A. P. Thurston said: "It was on top of a 'bus in Birmingham in 1919 that The Newcomen Society was born. The 'bus was taking some of us to the railway station after an inspection of a Watt engine—which in those days still worked. There were Messrs. Titley and Greener (Birmingham manufacturers and organizers of the Watt Centenary in which we had all been taking part), Dr. W. H. Dickinson, Mr. Rhys Jenkins, and other engineers from the south. They decided then and there to form a society to bring together people interested in the history of engineering."

The first Newcomen meeting was held in London, Nov. 5, 1920, and the constitution was adopted on Nov. 16, 1921. Arthur Titley was the first president, and Dickinson, honorary secretary and treasurer. Pendred, editor of *The Engineer*, and Eng. Comm. Edgar C. Smith, who still provides *Engineering*, *Nature*, and other magazines with articles on engineers and scientists from his vast collection of biographical material, were members of the Council. The first list of 121 members carries the names of four Americans, including the late L. F. Loree, president, Delaware and Hudson Railroad, and the late Harrison W. Craver, director, Engineering Societies Library.

In 1923 Dr. Dickinson made a trip to the United States in connection with the centennial of the Delaware and Hudson, and, with the aid of Mr. Loree and Charles Penrose, who became a member of the Council in 1924, initiated a movement to establish an affiliated body in America. Dickinson succeeded in interesting a group of distinguished American engineers, industrialists, and educators, in the new society. In 1925 the first meeting of American Newcomen was held at The Engineers' Club, New York, and C. E. Davies, secretary, ASME, became honorary corresponding secretary; later, first American president of The Newcomen Society. Under the energetic leadership of Dr. Charles Penrose, senior vice-president for North America, the American Newcomen has grown from the 49 members of 1925 to several thousands, scattered throughout the United States and Canada. It holds luncheon and dinner meetings almost weekly in all parts of both countries and issues its own publications in the form of beautifully printed Newcomen addresses, each devoted to some significant personality or enterprise. In 1938, Dickinson was the guest of American Newcomen. He spoke at many meetings and took part in one of the "pilgrimages" amid scenes of historic interest. He was thus able to comprehend the significance of the task American Newcomen had set for itself, which differed in some particulars from that being carried on by the parent body, and became in a very real sense an "ambassador" between the two English-speaking groups.

A tribute to Dickinson appeared in *Engineering* for Feb. 22, 1952, in the Hobhouse Memorial Lecture, "Technology and History," delivered by Prof. Charles Singer, the British medical historian, at the London School of Economics on Oct. 23, 1951. Toward the end of the address Dr. Singer spoke of Dickinson and Charles Frémont, the Frenchman, who died in 1930, as "undoubtedly the leading modern authorities on the history of the subject (technology)."

"Scholarship on the scale of that of Frémont and Dickinson has in it something of the heroic," he said. "Such singleness of purpose, such learning, such skill, such penetration, inevitably affect the character of those who exhibit them. The contemplation of their lives induces a reflection on the effect on these fortunate and happy-minded men of the single-minded pursuit of truth. The patterns of conduct and character molded by devotion to science are, of course, different from those determined by devotion to religion. Though different yet they are not wholly different. The mood in which such scientific men approach their tasks is surely derived from something very near to 'that subtle living, clear, and undefiled thing that is more moving than any motion and goes through all things by reason of her pureness, yea, Wisdom, which is the artificer of all things.'"

At a time when the influences of technology and engineering are raising the standards of living in countries where they have been most actively developed and are at work on the social, economic, and political institutions of the entire world, men like Dickinson remind us how humble we should be in contemplating the rich heritage the past has bestowed upon us and how great for us are the obligations and the opportunities to preserve and enhance that heritage. It should in no way detract from the credit owing to others to recognize Dickinson as The Newcomen Society personified, and to express the hope that the work to which he gave so many years of his life and so much of his energy and leadership will be carried forward with vigor and enthusiasm. This should constitute a fitting memorial to Henry Winram Dickinson who rescued from undeserved oblivion so many pioneers of engineering.

Changing PHILOSOPHIES *on* WAGE INCENTIVES

By HAROLD B. MAYNARD

PRESIDENT, METHODS ENGINEERING COUNCIL, PITTSBURGH, PA. MEMBER ASME

OF THE benefits which can be gained from a sound wage-incentive installation, there can be no question. Experience has amply demonstrated that wage incentives can increase earnings, raise production, and decrease costs. Why is it then that although there have been many, many successful wage-incentive installations, there also have been those that have failed altogether, and still others which have gone on only with great difficulty along a road strewn with grievances? The answer to this question can be found by reviewing the lessons which have been taught by experience with incentives over the years that they have been used.

From the standpoint of the engineers who install wage-incentive plans, the period during which it was easiest to do this type of work successfully was from the end of World War I to the beginning of the big depression. The mistakes made during earlier years were recognized and corrected, and the problems which arose in the 1930's had not come to the surface.

TAYLOR THE FATHER OF SCIENTIFIC MANAGEMENT

The major impetus to the use of wage incentives started with the work of Frederick W. Taylor, the father of scientific management. Among other things, his creative mind led him to develop a system of time study and presently a formula for getting maximum production. His formula was as follows:

"The greatest production results when each worker is given a definite task to be performed in a definite time and in a definite manner."

This is the principle upon which all of our modern ideas of effective production are based. In Taylor's time, the definite task was specified after a study of the job had determined the best operation sequence. The definite time was established by time study. The manner or method was developed by painstaking experimentation and was recorded for the benefit of the worker on an instruction card.

Taylor recognized the importance of method, and his accounts of pig-iron handling, metal cutting, and the like, are classic examples of early methods studies. Frank and Lillian Gilbreth during this same period repeatedly emphasized the importance of finding the one best way and further stressed the importance of recognizing the human factor in the work situation and the desirability of having the worker participate in the development of the best methods of doing the work.

As is so often the case, however, these pioneers were in some respects ahead of the times. The results obtained by stopwatch time study and the application of wage incentives were so spectacular that many of those who subsequently attempted to apply Taylor's techniques lost sight of the factor of method altogether. Their procedure was to time-study a job, accepting without question the method being used by the operator, establish a production standard, and then apply it under a wage-incentive plan. Large production increases were obtained, costs were reduced, and the work paid off handsomely.

PERIOD OF FALSE PRODUCTION STANDARDS

Difficulties developed, however, when production increased considerably more than was expected. Because the method had received scant consideration prior to the application of incentives, many possibilities for improving it existed. When the operator was told that the more he produced the more he would earn, he began to study methods in earnest. In some cases he found that major improvements could be made, and his production—and his earnings—increased far beyond what had been anticipated.

Many managers of that period had the feeling that a given worker was worth only so much. They were willing to see a nominal bonus earned in exchange for a considerable increase in production, but, when earnings rose above what they thought they should be, they became actively disturbed. Usually their procedure was to revise the standard, either as the result of an out-and-out rate cut or as the result of a management-made methods change. In either case, the earnings of the worker were reduced. It did not take him long to realize that it was not safe to earn more than a certain amount. As a result, a ceiling on earnings was tacitly agreed to by the workers which was seldom exceeded.

This situation resulted in what was apparently a very satisfactory condition. Earnings were quite consistent—because they were pegged by the workers. Standards established by time study looked accurate because they produced anticipated earnings. The operators in most cases put in a reasonably full day's work, because the incentive to improve methods beyond a point which permitted the agreed-to top earnings was lacking. All this tended to make the installation engineer feel that his work was sound and gave him a confidence in the effectiveness of his procedures which in many cases was far from justified.

The installations of this period were made largely as the result of unilateral decisions. If management decided to install an incentive plan, it selected the plan, established the standards, and started the plan in operation at the time which best suited its own convenience. True, the more advanced managements endeavored to "sell" the plan to the workers, but the product was largely management's product, designed without benefit of market research to see what the customer really wanted.

In doing the selling, the principal benefit which was offered was increased earnings. This fitted the philosophy of the times quite well. Rugged individualism was popular and everyone was interested in making more money for himself. So the money benefit was accepted, and the incentive which it provided caused the workers to pitch in and make even a poorly conceived wage-incentive plan work reasonably well.

WORKERS DEVELOP THE SLOWDOWN TECHNIQUE

But then the situation changed. In the early 1930's the big

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depression struck. Suddenly security came to be the thing to be desired above all others. Instead of higher earnings, steady earnings seemed more important. With only a limited amount of work to be done, many workers began to feel that instead of doing it more quickly, making higher earnings temporarily and then getting laid off, it was better to do the work more slowly so that it would last longer. And presently, as the depression deepened and more and more workers were laid off, the feeling that the work should be produced even more slowly so that a group of workers could keep their jobs received increasing acceptance among the workers themselves. The high producer, instead of receiving recognition and approval for his superior ability, was regarded by the workers as a threat to their security. They made their disapproval clear in no uncertain terms and discouraged the high producers from giving their best efforts.

This period did not last long, but it had a profound effect on those who lived through it. Management's attitudes were shaped by the happy 1920's. They wanted to continue to make unilateral installations; they felt that their time-and-motion-study procedures were sound; they continued to rely on the appeal to the desire of the individual to make higher earnings in selling wage incentives to the workers. But the workers had changed their minds about the rightness of high individual earnings. They were even not quite sure that high productivity in general was socially desirable. So the stage was set for trouble as the unions began to grow, with enough tensions on both sides to cause many, many difficulties.

UNIONS STEP IN

Of course all this did not unfold in the orderly way in which I have described it. The trends which are so clear to the historian are not so clear when they are developing. It is easy to confuse effects and causes as one goes through a period of change. For example, as the unions grew in power, the workers became less fearful of breaking through earnings ceilings. When they found that the union could successfully oppose changes in standards, earnings began to rise rapidly in plants where there was enough work ahead to minimize the threat of a layoff. Latent methods improvements were put into effect by the workers and earnings went still higher. Some jobs were more susceptible to improvement than others. As a result, inconsistencies in earnings occurred which created further problems. As this situation unfolded, the importance of establishing effective working methods prior to time study became apparent. In an attempt to correct an undesirable situation, some managements went from an almost complete neglect of methods study to a more and more detailed consideration of method. This was a desirable thing to do, of course, but it was not the complete solution to the problem which some managements hoped.

Other managements tried other solutions. In the automobile industry, for example, the attempt was made to get rid of the problems caused by direct incentives by going to measured daywork. At the outset, the workers agreed that if they were paid their present average earned rate, they would continue to maintain their same output. They even agreed that the worker who did not keep up could be discharged. To management, this seemed to be a solution to many problems. Inconsistencies in earnings immediately would be eliminated. Since earnings were not tied directly to the standard, it was felt that the pressure would be taken off the rate setter and management for complete accuracy and that a better human-relations situation would result.

However, it did not work out that way. Human nature being what it is, little by little performance deteriorated. The burden of proof as to whether a given performance was acceptable was on management, and it became increasingly difficult to enforce high effort by disciplinary measures. As one manager put it, "When measured daywork first came along, we could make it work because we still had a fist. But then the unions stepped in and cut off the fist."

The net result of measured daywork, therefore, was a performance level which gradually approached the unmeasured daywork level. Most companies, who were able to measure and compare the results obtained after direct incentives were replaced with measured daywork, reported that production fell off by at least 25 per cent. It was just too difficult to enforce the penalties provided in most measured daywork plans.

In spite of all the problems involved, many companies continued to use and expand their use of wage incentives all through the difficult 1930's. They paid an increasing amount of attention to method, they strove for greater accuracy in setting standards, they gave guarantees which eliminated certain abuses of the past, and more and more they consulted with their workers on wage-incentive problems, either voluntarily or because their unions forced them to. They demonstrated that wage incentives, properly and intelligently administered, still brought good results, and they paved the way for the next development which came with the beginning of World War II.

A NEW APPROACH TO WAGE INCENTIVES

At that point the need for greater production suddenly became apparent to nearly everyone. The make-work and slowdown attitudes born of the depression did not die immediately, but they were more or less pushed into the background for the duration. The War Production Board, desperate for more and more production, strongly advocated the use of wage incentives under certain conditions. The conditions, happily, were drawn up by men who understood wage-incentive problems and served to create an understanding of sound wage-incentive practices among a much larger segment of the industrial population than had known about them before.

The War Production Board insisted on approving all new wage-incentive plans. Before they would consider a new plan, an application for approval had to be submitted, jointly signed by both management and the union if a union was involved. In this connection it is interesting to note that 43 per cent of the plants which proposed wage-incentive plans to the War Production Board had unions who joined in submitting the request for approval.

This condition of joint action in connection with wage incentives created some interesting new problems for management. Previously, when the decision was unilateral, management could proceed at its own pace. It could decide that a certain activity was to be placed on incentive. It then could study the work as thoroughly as it wished. The standards could be established and tested, and the plan could be developed in every detail before it was discussed with the workers. Management could go to the workers with a completely developed package, and, although it was management's package, management at least knew what it was that it wanted to sell.

When it is necessary first to get union and then government approval for a new plan, the problem is more complicated. The initial stages are more difficult, for the union wants to know every detail about the plan before it signs and is in a position to force consideration of its own wishes and desires. This is not necessarily undesirable, however, and certainly presents no problems that management cannot solve.

UNIONS DEMAND SPEED IN PUTTING WAGE INCENTIVES INTO EFFECT

The real difficulty occurs after the union has once decided that it wants a wage-incentive plan and has helped get government approval. At this point the union usually wants the

plan put into effect immediately so that the benefits which the workers are to receive can be had as soon as possible. Strong pressure is exerted to install the plan at once, and management is often forced to act with a haste which is not conducive to soundness.

Up to the time that approval is given by the government agency, management is likely to procrastinate on getting ready. It is not sure that the plan will be approved and, understandably, does not wish to spend substantial sums of money preparing for it which will be wasted if approval is not obtained.

But then one day word is received from Washington that approval has been given. Almost simultaneously, the union wants to know when the plan will be put into effect and in the same breath asks why it cannot be done sooner. So management usually first gives orders to hire a number of new industrial engineers—which is impossible—and then to select a number of people who seem to be good material and train them in time-and-motion-study techniques—which takes time even on an accelerated basis. It keeps constant pressure on the industrial-engineering function to rush the setting of standards so that incentive payment can begin. There is grave danger that when the plan is finally put into effect, it will be based on insufficient study and analysis, inaccurate standards, and inadequately thought-through administrative procedures.

HASTE MAY RUIN THE PLAN

More serious than this—and this is really the whole point of this paper—because of the pressure and haste which is often involved, the plan itself may be improperly conceived. If there is one lesson to be learned from past experience with wage incentives, it is that the plan must be tailored to the needs and basic beliefs of the group who will work under it if it is to be acceptable. We can assess present-day needs and beliefs on a broad basis as we have been doing with those of the past, and this will help. But each individual and each group is somewhat different from the rest, and this must be taken into account. In addition, basic beliefs and attitudes change.

For example, we are fond of saying that incentives in effect put a man in business for himself. As long as the social climate is such that being in business for oneself is considered desirable, this is a good sales approach. In a country which has adopted socialism, however, the individual who is working for himself is considered somewhat out of step with the rest. If he makes a great deal more money than the rest, he is regarded as practically antisocial. In England, up to the time of the recent election at least, if a man earned more than a certain rather modest amount, he was regarded with suspicion by his friends and associates. In such a social climate, the fact that a wage-incentive plan "puts a man in business for himself" is not an acceptable reason for adopting it. A plan which purports to raise the productivity of a group of workers "for the benefit of all" will have a better chance of success.

Of course most American managers believe in individual incentives and strive to maintain our free competitive profit-and-loss system. I am not for a minute suggesting any retreat from this position, for I believe in it wholeheartedly myself. But the point is that if the workers in a given plant have adopted a somewhat different viewpoint—say, a "one for all and all for one" attitude—it is unwise to attempt to run head-on against this attitude. Either the attitude should be altered by careful education and persuasive activities—for which there is usually not time—or the plan should be tailored to suit the attitudes of the group.

This latter course of action is by far the best and, indeed, is one that wage-incentive engineers have been following, perhaps without realizing it, for years. In the early days of wage incentives, for example, wage-incentive plans which placed a limit on earnings were quite popular. In England, the Rowan plan which permits theoretical maximum earnings of a bonus of 100 per cent was quite popular. The actual practical limit was much lower. This plan coincided well with the attitudes of English labor which for many years has felt that the restricting of output is socially desirable.

THE ROWAN AND HALSEY PLANS

The Rowan plan, however, was never really popular in America, for prior to the 1930's, the workers were much more interested in increasing earnings than in limiting output. Therefore they favored a plan which would permit unlimited top earnings. This was satisfactory to management as long as the earnings were not "runaway" earnings caused by a loose standard or a major methods improvement made by the operator. In this period, the plan which seemed to meet the requirements of both management and the workers the best was the Halsey Premium Plan, and it was widely and successfully used. The plan provided that the difference between the hours allowed and the hours worked or the time saved would be split between the company and the worker, usually on a 50–50 basis. It was often called a gain-sharing plan.

In presenting this plan to the workers, management of course did not mention its fear of loose standards and runaway earnings. Instead, it justified the 50–50 split of the bonus by pointing out that there would be greater wear and tear on machines and tools as the workers ran them faster, that it cost something to pay the rate setters who made incentive payment possible, and the like. These points seemed reasonable enough to the workers at the time, and as long as the standards were set loosely enough so that they could make time and a third or time and a half, they went along.

Presently as the years passed, these attitudes changed. Management did not like the loose standards of the Halsey plan. They made production planning difficult, confused cost estimating, and so on. Time-study and methods techniques had improved, so there was no longer so much fear of inaccurate standards.

The workers, on their part, were finding it less easy to see why they should share the bonus they apparently earned with management. They felt they should receive all the bonus they earned or, in other words, that they should get a one per cent increase in earnings for every one per cent increase in production. Therefore, incentive plans of the 1-for-1 type, based upon somewhat tighter standards, came into vogue because both management and the workers found them more in line with their current attitudes.

THE TAILORED WAGE-INCENTIVE PLAN FAVORED

At the present moment the idea of carefully tailoring a wage-incentive plan to the group it is going to affect is gaining increasing acceptance. There is great interest in improving existing incentive plans and extending their application further and further. There is a growing feeling that the ideal incentive plan has yet to be developed and a willingness on the part of some managements and unions to pioneer in this direction.

For example, a certain plant recently desired to put its tool-and-die-making activity on an incentive basis. The union was willing to go along but suggested a department-wide incentive so that all workers would earn the same percentage bonus, a group-minded attitude. There were 48 operators in the department, however, doing highly miscellaneous work in small lots. The management was advised by qualified counsel that experience had shown that incentive groups of 48 people just did not work out well on miscellaneous, small-quantity work.

Instead of allowing this to create an impasse, the management

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DESIGN *Factors for* INDUSTRIAL HEAT-PUMP INSTALLATIONS

By R. J. MARTIN

ASSOCIATE PROFESSOR OF MECHANICAL ENGINEERING, UNIVERSITY OF ILLINOIS, URBANA, ILL.

THE application of the heat pump as a means of heating buildings of the commercial and residential type has received much attention from heating and refrigeration engineers in the past few years. Such systems employ a conventional refrigeration cycle in which the evaporator absorbs heat from the atmosphere, ground, or other source, and the condenser of the refrigeration cycle rejects heat at the higher condensing temperature. By means of a suitable medium, such as water or air, this heat is utilized for offsetting the heat losses of the building. The amount of heat thus made available is essentially the sum of the heat absorbed by the evaporator and the heat equivalent of the electrical energy required to drive the refrigeration compressor. One advantage claimed for this system is the possibility of its use for summer air conditioning, in which case the functions of the heat-pump evaporator and condenser are interchanged so that heat is absorbed from the building and rejected to the atmosphere, or other suitable heat sink.

Other applications of the heat pump, such as public swimming pools, skating rinks, and the like, which have been in operation both in this country and abroad, have been discussed in the literature.[1,2,3] However, except in a few special applications such as for the low-temperature evaporation of milk and fruit juices, little information has been made available on the application of the heat pump for installations in which the refrigeration effect produced is of primary consideration. The broad objectives of this paper are to discuss the feasibility and limitations of the heat pump for industrial applications in which a refrigeration load is also a requirement, and the factors which affect the design and operation of this type of heat-pump system.

POSSIBLE INDUSTRIAL USE OF HEAT PUMP

The processes required by many types of industries for product manufacture necessitate the use of mechanical refrigeration equipment to maintain reduced temperatures. Generally, in these same industries, there also is a need for heated water for such uses as cooking, process control at moderate temperatures, cleaning operations, and as a part of the product. The usual procedure is to "waste" the heat being rejected from the refrigeration cycle of the condenser by means of a spray pond, a cooling tower, or ground water used on a once-through basis. On the other hand, the fresh water which is required for processing is obtained normally from the city main or deep well at relatively low supply temperature and must be heated to the desired temperature by means of heat supplied by the combustion of fuel with or without the use of secondary heat exchangers. Such industries, from an economic standpoint, should investigate the possible use of the heat pump in one or both of the following applications:

1 A heat pump to absorb waste heat[4] from the product or by-products at the highest temperature possible, and in turn to provide heat at a still higher temperature to the process water, or to provide process control at elevated temperatures.

2 A heat pump to provide useful refrigeration at the required low temperature and simultaneously to provide a means of preheating the process water. An important additional advantage of this system is the elimination of a separate supply of condenser cooling water since the process water, being preheated, serves this function.

To justify the use of a heat pump in a given industrial plant, it must be competitive with other methods from the standpoint of (*a*) investment and operating cost, (*b*) flexibility of control, (*c*) freedom from operating difficulties, and (*d*) ability to meet maximum loads without affecting performance seriously.

INVESTMENT AND OPERATING COST

The investment cost of the type of industrial heat pump which does not provide useful refrigeration must be competitive with the investment cost of the boiler, fuel-handling equipment, piping, auxiliaries, and heat exchangers which could supply this same quantity of heat. If the heat required for the application is at temperatures of the order of 60 to 80 F higher than the temperature of the heat source, such as for existing space-heating systems, and if no power generation is required of the same system, the heat pump has been found to be competitive in investment cost.[3] The analysis of such costs of course should take into consideration the depreciation and maintenance of each type of system.

The investment costs of the heat-pump installation which simultaneously provides useful refrigeration cannot be considered entirely on the basis of the heat supplied, since the refrigeration-equipment cost is primarily chargeable to the refrigeration load, and little or no additional equipment is necessary to make the heat rejected from this refrigeration system available for process water heating. If additional heat-pump equipment is necessary to bring this process water to the temperature required for use, this additional equipment should be compared in cost with other methods of supplying the required additional heat.

The cost of the heat supplied by means of the heat-pump system may be compared with the cost of heat as supplied by the combustion of fuels such as coal, oil, or gas. Since the heat pump supplies an amount of heat equal to the heat absorbed at the evaporator of the system plus the heat equivalent of the work done by the compressor on the refrigerant, the cost of the heat supplied will vary with the efficiency, or performance, of the heat pump. For purposes of the paper, the

[1] "Heat-Pump Applications," by E. N. Kemler and S. Oglesby, Jr., McGraw-Hill Book Company, Inc., New York, N. Y., 1950.

[2] "Heat-Pumps," by P. Sporn, E. R. Ambrose, and T. Baumeister, John Wiley & Sons, Inc., New York, N. Y., 1947.

[3] "The Heat-Pump, Its Practical Application," by J. R. Pinkerton, Princes Press, Ltd., Westminster, S.W.1, England, 1949.

Contributed by the Process Industries Division and presented at the Annual Meeting, Atlantic City, N. J., November 25–30, 1951, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

[4] "Heat Pump Expected to Find Use in Waste Heat Recovery," by C. F. Kayan, *Chemical Engineering*, vol. 57, 1950, pp. 146–147.

performance of the heat pump and the performance of the refrigeration system are defined by the following equations:

$$\text{Heat-pump performance ratio} = \frac{\text{Heat supplied at condenser, Btu/hr}}{\text{Compressor power consumption, Btu/hr}}$$

$$\text{Coefficient of performance} = \frac{\text{Useful refrigeration, Btu/hr}}{\text{Compressor power consumption, Btu/hr}}$$

The cost of the heat supplied by a heat pump as affected by the heat-pump performance ratio is shown in Fig. 1. At a performance ratio of 1.0, the cost is equivalent to that of an electric-resistance heating system. As the heat-pump performance ratios are increased, the heat supplied by the system per unit of required electrical energy is also increased. This fact results in a reduced cost of the heat supplied. It will be shown that increasing performance ratios are obtained as the temperature difference between the evaporating and condensing refrigerant temperatures of the heat pump are decreased.

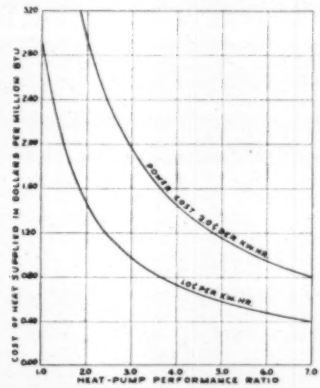

FIG. 1 COST OF HEAT SUPPLIED BY A HEAT PUMP

The equivalent unit costs which are required for the various fuels to be competitive with the heat pump are shown in Table 1. The unit heating value, and the utilization efficiency of the heat supplied by these fuels, as well as the unit cost for electrical energy will affect the equivalent costs listed in Table 1. Revised equivalent costs may be computed readily by means of the formula.

As in the case of investment costs, the cost of the heat supplied by a heat-pump system which also provides useful refrigeration should be adjusted to account for the electrical energy which normally would be required for the refrigeration load.

TABLE 1 EQUIVALENT COST OF FUELS AS COMPARED TO HEAT-PUMP PERFORMANCE RATIO*

Heat-pump performance ratio	Coal—bituminous, dollars per ton	Fuel oil—no. 5 grade, cents per gal	Gas, natural, cents per therm
1.0	33.68	21.7	14.6
2.0	16.84	10.8	7.3
3.0	11.23	7.2	4.8
4.0	8.42	5.4	3.6
5.0	6.74	4.3	2.9
6.0	5.62	3.6	2.4
7.0	4.82	3.1	2.1

* Based on 50 per cent utilization efficiency for fuels and 1 cent per kwhr for electrical energy to compressor. Assumed heating value for fuel: coal = 11,500 Btu per pound; oil = 148,000 Btu per gal; gas = 1000 Btu pcf. For other heating values or electrical-energy costs use the following equation to determine equivalent costs (EC):

$$EC = \frac{H_t m C}{3415 R \epsilon}$$

where

EC = equivalent cost of fuel in cents per unit
H_t = calorific value of fuel, Btu per lb
m = pounds per fuel unit
C = cost of electrical energy, cents per kwhr
R = heat-pump performance ratio
ϵ = utilization efficiency of fuel, per cent

PERFORMANCE OF HEAT-PUMP SYSTEMS

As previously stated, the heat pump is essentially a conventional refrigeration cycle in which the heat rejected at the condenser is made available for useful purposes. Therefore the performance of the heat-pump system must be related directly to and will be dependent upon the performance of the refrigeration cycle. The refrigeration cycle, in its simplest form, is composed of (*a*) an evaporator which permits the transfer of heat from an available source to the refrigerant, thereby evaporating the refrigerant at a given pressure and corresponding saturation temperature; (*b*) a compressor which increases the pressure and temperature of the refrigerant vapor; (*c*) a condenser which permits the transfer of heat from the refrigerant vapor to the condenser water or other condensing medium, thereby condensing the refrigerant at a given pressure and corresponding saturation temperature; and (*d*) an expansion valve which regulates the flow of refrigerant from the high-pressure to the low-pressure side of the system.

The principal variables which affect the performance of the refrigeration cycle and, therefore, the performance of the heat-pump system are as follows:

1 Evaporating temperature, i.e., the saturation temperature of the refrigerant corresponding to the evaporating pressure.

2 Condensing temperature, i.e., the saturation temperature of the refrigerant corresponding to the condensing pressure.

3 Rate of flow of condensing cooling water.

4 Inlet temperature of condensing cooling water.

5 Power required to drive the compressor—which in turn depends upon the refrigerant used, the volumetric efficiency of the compressor, and the compression efficiency of the compressor.

6 Relative size of the compressor and condenser.

In order that the operating characteristics of refrigeration compressors as affected by the foregoing variables might be analyzed, five compressors made by three manufacturers were selected arbitrarily for study. These compressors were all designed to operate with Freon-12 as a refrigerant and include both condensing units and separate compressors. Also, the compressors selected represent a wide range of capacities and speeds. The pertinent physical data and rated capacities of these compressors are shown in Table 2. In all cases, the compressors had been tested and rated by the manufacturers in accordance with the code of the American Society of Refrigerating Engineers, and these manufacturers' published catalog data were used in this analysis. For purposes of rated capacity, the conditions of operation specified by the American Society of Refrigerating Engineers' Group III rating[5] were used. The conditions of this rating are (*a*) an evaporating temperature

[5] "ASRE Standard Methods of Rating and Testing Refrigerant Compressors," ASRE Circular No. 23, The American Society of Refrigerating Engineers, New York, N. Y.

TABLE 2 PHYSICAL DATA AND RATINGS FOR FIVE REFRIGERATION COMPRESSORS[a]

Designation of compressor	Designation of manufacturer	Number of cylinders	Rpm	ASRE Gr. III[b] rating, tons	Type of compressor
1	A	4	600	13.3	Condensing unit
2	A	8	850	38.0	Condensing unit
3	B	2	400	59.0	Separate compressor
4	B	2	600	12.3	Separate compressor
5	C	2	1750	2.2	Condensing unit

[a] Type of refrigerant, Freon-12.

[b] Evaporating temperature = 20 F, condensing temperature = 105 F, compressor suction temperature = 65 F (for details see ASRE Circular No. 23).

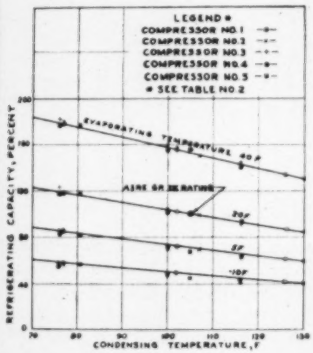

FIG. 2 REFRIGERATION CAPACITY FOR VARIOUS CONDENSING AND EVAPORATING TEMPERATURES

of 20 F; (*b*) a condensing temperature of 105 F; and (*c*) a refrigerant-vapor temperature entering the compressor of 65 F.

The effect on refrigeration capacity of various condensing and evaporating temperatures is shown in Fig. 2. The points represent values for the five compressors listed in Table 2. The agreement between the various compressor capacities, expressed as a percentage of rated capacity indicates that, over a wide range of compressor sizes and operating speeds, the volumetric efficiency of these compressors varies by the same magnitude in relation to the conditions of rating. This is apparent since the volumetric efficiency was the only significant variable between various compressors. Such factors as pressure ratio and the specific volume of the refrigerant vapor at suction are the same for all compressors for any given combination of condensing and evaporating temperatures, and, therefore, these factors will have the same effect on a percentage of rating basis regardless of the design or size of the compressor. The curves in Fig. 2 indicate that the refrigeration capacity of a given compressor will increase with decreasing condensing temperatures or with increasing evaporating temperatures. Of these temperatures, the evaporating temperature is the more critical since a change in this temperature affects both the mass rate of flow of refrigerant handled by the compressor and the refrigeration effect per pound of refrigerant circulated by the system. On the other hand, changes in the condensing temperature have little effect on the mass rate of flow and primarily cause a variation of the refrigeration effect per pound of refrigerant circulated.

From a practical standpoint, the variation in evaporating temperature is more difficult to predetermine and to control since this evaporating temperature depends, to a large extent, on the nature of the heat source or on the type of load when a required refrigeration load is to be provided by the system. If the refrigeration system provides chilled water or brine by means of a flooded shell-and-tube evaporator, the evaporating temperature tends to be quite stable as compared to direct-expansion systems utilizing unit coolers or expansion coils, for the control of air-stream or space temperatures. Also, these latter systems are often regulated by "off-on" operation by means of a thermostat which results in a fluctuation of available heat at the condenser for heat-pump operation. In any case, the highest evaporating temperature consistent with the requirements of the system should be employed in the design and operation of a heat-pump system.

In the operation of an industrial heat-pump system, it may be desirable to increase the condensing temperature in order to provide for higher temperatures of the leaving condenser water. If, in addition, it is desirable to maintain a constant refrigeration capacity, the evaporating temperature also must be increased as indicated by the curves in Fig. 3. These curves, which were calculated from data on the five compressors listed in Table 2, show the interrelation between evaporating and condensing temperatures for constant refrigeration capacity of the compressor. For 100 per cent rated capacity, it may be seen that an increase in evaporating temperature of 10 F requires a compensating increase in the condensing temperature of about 30 F. Again this illustrates the relative importance of the evaporating temperature in regard to compressor capacity.

The curves in Figs. 2 and 3 were based on catalog data for the five compressors listed in Table 2. The performance data

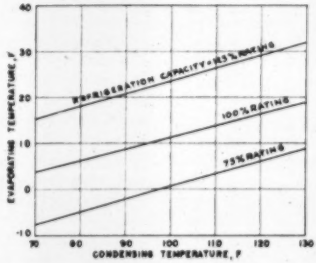

FIG. 3 EVAPORATING TEMPERATURES REQUIRED FOR CONSTANT REFRIGERATION CAPACITY FOR VARIOUS CONDENSING TEMPERATURES

which were used as a basis for the remaining figures are restricted to those of compressor No. 1. This was found necessary since the compressor motor efficiencies varied slightly, and the compressor-condenser size relations also varied for these five compressors. However, the trends and interrelation of the variables to be discussed are not related to a single compressor but apply equally well to all the compressors studied. Hence the data may be considered in the light of predicting performance characteristics of heat-pump systems when the operating conditions are varied from those selected for design.

The power required to operate the compressor expressed as a percentage of that power required under the ASRE Group III rating conditions is shown by the curves in Fig. 4. These curves illustrate that, in general, as the evaporating tempera-

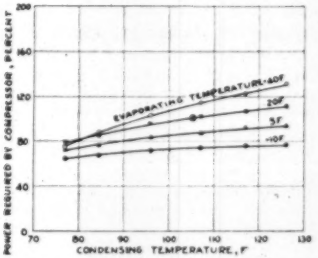

FIG. 4 COMPRESSOR POWER REQUIRED FOR VARIOUS CONDENSING AND EVAPORATING TEMPERATURES

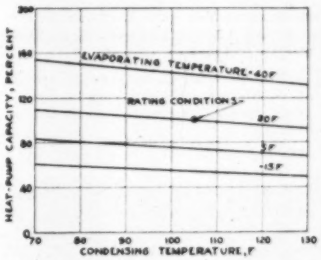

FIG. 5 HEAT-PUMP CAPACITY FOR VARIOUS CONDENSING AND EVAPORATING TEMPERATURES

ture increases, the power required also increases. This increase in the power required by the compressor occurs in spite of the reduced power requirements per ton of refrigeration since the actual refrigeration capacity of the compressor is increased appreciably by the increased evaporator temperature. The increase in the power required by the compressor due to an increasing condensing temperature may be explained by the fact that the increased power requirements per ton of refrigeration more than compensates for the decrease in refrigeration capacity of the compressor as was shown previously in Fig. 2. The increased power requirements per ton are due to (*a*) the decreased refrigeration effect per pound of refrigerant circulated and (*b*) the increased work of compression per pound of refrigerant circulated.

The curves in Fig. 5 were obtained by adding the refrigeration capacity of the compressor and the heat equivalent of the work of compression for the various conditions of evaporating and condensing temperatures. The resulting heat-pump capacity then was expressed as a percentage of the capacity obtained for the conditions of the ASRE Group III rating. It is of interest to compare the heat-pump capacities with the refrigeration capacities shown in Fig. 2. In the case of refrigeration capacity, an increase in the condensing temperature of 10 F results in about a 7 per cent decrease in capacity with an evaporating temperature of 20 F. However, for these same conditions, the heat-pump capacity is decreased only about 3 per cent as a result of the increased power requirements of the compressor with increasing condensing temperatures. Thus, from the standpoint of heat-pump capacity alone, the change of condensing temperature due to conditions of operation of the condenser have little effect on performance.

The heat-pump performance ratios for the various condensing and evaporating temperatures are shown in Fig. 6. These curves were determined by dividing the heat supplied by the heat pump at the condenser by the heat equivalent of the power required by the compressor. Since increasing performance ratios are indicative of increased heat supplied by the heat pump per unit of power input, it is desirable, from the standpoint of a minimum operating cost, to utilize minimum condensing temperatures and maximum evaporating temperatures. However, in the practical application, it may be necessary to sacrifice the higher performance ratio in order to control the temperature of the water leaving the condenser of the heat pump at the desired level by increasing the condensing temperature. It should be recalled that an increase of condensing temperature has little effect on either the refrigeration or heat-pump capacity of the system even through it produces a marked change in the performance ratio.

The coefficient of performance of the compressor is also shown in Fig. 6 as it is of importance when useful refrigeration is being provided by the system. The foregoing statements regarding the heat-pump performance ratio apply equally well to the coefficient of performance since these factors are related directly by the work of compression of the compressor.

The evaporating temperature of the refrigeration cycle which serves the heat pump is normally fixed for design purposes by either the temperature and nature of the heat source or the requirements of the refrigeration load when useful refrigeration is to be provided. This evaporating temperature will vary during actual operation owing to the changes in the heat source or changes in the refrigeration load. Assuming a constant compressor operation, the system will seek some new balance point between suction-pressure conditions and compressor capacity. The actual balance point will depend upon the size and type of the evaporator in relation to the compressor size. Such variations of the point of control have been discussed previously.[6] For any given evaporating temperature, however, the primary variable in the performance and operation of the heat-pump system is the condensing temperature.

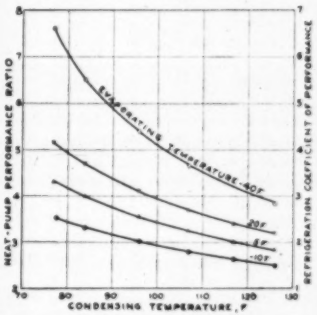

FIG. 6 HEAT-PUMP PERFORMANCE RATIO FOR VARIOUS CONDENSING AND EVAPORATING TEMPERATURES

The actual condensing temperature of a refrigeration cycle is dependent upon (*a*) the condenser inlet-water temperature, (*b*) the rate of flow of the condenser water, (*c*) the design of the condenser, and (*d*) the interrelation of the compressor and condenser size. The relative importance of the first two of these variables may be shown best by a study of published data on condensing units, since the compressor and condenser have fixed size relationships, and the type of condenser is also fixed.

[6] "Automatic Capacity Controls," by W. L. McGrath, *Refrigeration Engineering*, vol. 43, no. 3, 1942, p. 188; vol. 43, no. 4, 1942, p. 248.

The condensing temperatures which result from various condenser water flow rates and various condenser inlet-water temperatures for a constant evaporating temperature of 20 F are shown in Fig. 7. For this analysis, the condenser-water flow rate has been reduced to units of gallons per minute per ton of refrigeration produced at the operating conditions required for the ASRE Group III rating. Since, for a given compressor, the capacity at rating conditions is a constant, a given condenser-water flow rate represents a fixed quantity of condenser water regardless of the actual capacity of this compressor due to the resulting condensing temperature. From Fig. 7 it

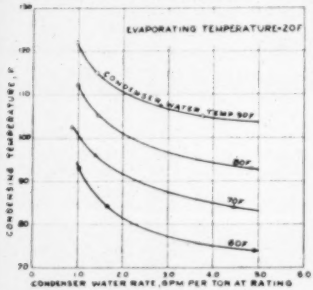

FIG. 7 CONDENSING TEMPERATURE RESULTING FROM VARIOUS CONDENSER-WATER FLOW RATES AND ENTERING CONDENSER-WATER TEMPERATURE

may be noted that for a given condenser-water flow rate of the order of 4 or 5 gpm per ton at rating, any increase in the condenser inlet-water temperature results in an increase of the condensing temperature of the same magnitude. This is due to the fact that the leaving terminal temperature difference between the condensing temperature and the condenser leaving-water temperature is relatively small, and is of constant magnitude under these conditions of operation. For a given condenser inlet-water temperature the condensing temperature increases as the condensing-water flow rate decreases since the reduced flow rate results in a greater temperature rise of the condenser water, and also in an increased leaving terminal difference. The same trends exist for other values of evaporating temperature.

By means of the condensing temperatures obtained from Fig. 7, and the curves in Fig. 2, the refrigeration capacity may be related to the condenser inlet-water temperature and condenser-water flow rate as shown

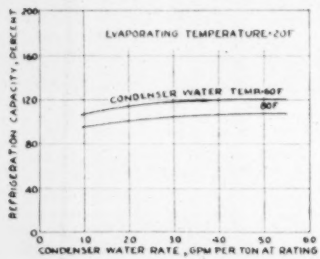

FIG. 8 EFFECT OF CONDENSER-WATER RATE AND CONDENSER-WATER TEMPERATURE ON REFRIGERATION CAPACITY

in Fig. 8. It should be noted that the refrigeration capacity decreases with decreasing condenser-water flow rate as well as with increasing condenser-inlet-water temperature. This is, of course, due to the increase in the condensing temperature as shown in Fig. 7. The heat-pump capacity also may be determined in the same manner, and as previously stated, would result in a smaller change in capacity than is evidenced in Fig. 8. However, the heat-pump performance ratio and the coefficient of performance will be affected materially by the change of condenser-water flow rate or condenser inlet-water temperature because of the resulting change in the condensing temperature.

The temperature of the condensing water as it leaves the condenser will depend upon the mass rate of flow, the condenser inlet-water temperature, and the heat rejected at the condenser by the refrigeration cycle. The magnitude of this condenser leaving-water temperature, as related to the condenser-water flow rate, and the condenser inlet-water temperature is shown in Fig. 9. This leaving temperature is normally of importance in the design of the heat-pump system since the usability of this water is dependent upon its temperature.

In the practical application of the heat pump in industry, it may be advisable to reduce the condenser-water flow rate to provide a higher process-water temperature. This may be done to a limited degree without affecting the capacity of the heat pump seriously. In cases which require a relatively small quantity of process water, the use of several condensers in series might be advisable to provide stability in the operation of the condenser and a maximum heat-pump performance ratio for the system as a whole. Also, a portion of the condenser water may be recirculated through the condenser which will result in a higher condenser-water flow rate, and an increased condenser inlet-water temperature. These methods of operation are preferable to the use of condenser-water flow rates less than 1 gpm per ton which cause unstable condenser pressure.

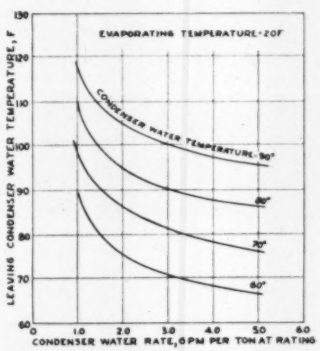

FIG. 9 LEAVING CONDENSER-WATER TEMPERATURE RESULTING FROM VARIOUS CONDENSER-WATER RATES AND CONDENSER-WATER TEMPERATURES

CONCLUSIONS

From the foregoing analysis, the following conclusions may be reached:

1 Industrial applications of the heat pump are often feasible from the standpoint of operating cost, particularly when useful refrigeration is required simultaneously by the same system.

2 The performance of the heat pump is primarily dependent upon the condensing and evaporating temperatures of the system. In general, the heat-pump capacity and heat-pump performance ratio are increased with increased evaporating temperatures and decreased condensing temperatures.

3 The principal factors affecting the heat-pump condensing temperature are the condenser inlet-water temperature and the condenser-water flow rate. The condenser-water flow rate is dictated normally by the need for process water, but may be increased where necessary by recirculation to the condenser.

4 The use of process water as a substitute for the condensing water normally required by a refrigeration system serves to reduce the water required by the industry in question. Consideration should be given to this method of water conservation in areas where suitable cooling water is in short supply.

PROGRESS *in* RAILWAY MECHANICAL ENGINEERING[1]

1950–1951

DIESEL-ELECTRIC POWER PREDOMINATES

THE gradual but steady evolution of the American railroads toward an operating philosophy, based on Diesel-electric instead of steam motive power, has been emphasized by the fact that during the first half of the current calendar year, a point was reached where Diesel-electric locomotives handled more than half of the freight service of the country's railroads. Similar statistics show that approximately three quarters of the yard-switching service and about two thirds of the passenger-train service are being conducted with Diesel power.

While the Diesel-electric locomotive is, by and large, the preferred type of motive power, efforts to produce competitive types to burn coal still continue, as evidenced by the several developmental projects under way in the United States, Canada, and European countries. Most of these endeavor to employ the gas turbine running in simple, regenerated, or exhaust-heated cycles, although one domestic activity will utilize the steam turbine as its source of prime power.

A gradual but definite trend toward greater horsepower in single Diesel-powered units is discernible not only in road power but in the switching-locomotive field. The possibilities with respect to higher horsepower per ton on drivers and per foot of length of locomotive inherent in the oil-burning gas-turbine locomotive are further impellents to the improvement in these qualities in the Diesel-powered units.

Developmental activity, involving mechanical drive as a substitute for the electric-drive system in the Diesel-powered locomotive, continues with the occasional production of an experimental unit, generally utilizing the hydraulic torque converter or coupling to approximate the elasticity inherent in the electric-drive system.

The conclusion of a trial period in which General Electric's pilot oil-burning gas-turbine-electric locomotive operated approximately 100,000 miles in revenue freight service, has been followed by an order for several units of this type of motive power. These units are intended for operation under conditions where relative oil-price levels are expected to make them competitive with Diesel-electric power.

Despite the overwhelming popularity and adoption of the Diesel-electric as the dominant note in domestic motive-power affairs, the electric-locomotive designers have succeeded in producing new designs which may prove to be the forerunners and prototypes of the electric locomotives of the future. European builders, motivated by a more immediate urge toward railroad electrifications, have been particularly active in developmental work projected to utilize commercial frequencies on the contact system.

Increasing attention to the necessity of improvement in freight-car journal bearings, with a view to minimizing on-road train detentions, is noticeable. New passenger-train cars constructed during the past decade invariably have been equipped with antifriction bearings, and an increasing number of freight-train units move from the builders' shops with this type of bearing. The higher cost of the antifriction bearing contrasted to that of the waste-packed type is the principal deterrent to the more extensive use of the former in freight-train cars. Increased per diem charges for cars equipped with antifriction bearings are being considered as one way to compensate for the higher initial costs involved.

STEAM LOCOMOTIVES

European builders—notably the British and Germans—continue to build steam locomotives with emphasis on standardization to decrease the number of classes in operation.

The German Federal Railways have developed a series of standardized designs for steam locomotives; and during the past year, 3 of a total of 15 standards have appeared from the shops of six locomotive builders in a total of 75 units. Details of the three designs so far completed are covered in Table 1,

TABLE 1 STEAM LOCOMOTIVES

	Item 1	Item 2	Item 3
Service	Pass	Pass	SW
Cylinders, in.:			
Bore	20.6	22.5	23.6
Stroke	26.0	26.0	26.0
Boiler pressure, psi	200	227	200
Driving-wheel diameter, in.	69	59	55
Weights, lb:			
Total, with tender	324600	238000	204000
On drivers	112600	145600	204000
Per driving axle	37550	36400	40800
Heating surfaces, sq ft:			
Evaporative	1681	1509	1315
Superheating	794	677	557
Grate area	33.5	28.6	25.3
Water capacity, gal	5700	2650	1935
Coal capacity, tons	7	4.3	3.6
Maximum speed, mph	68	53	43

items 1, 2, and 3, and are illustrated in Figs. 1, 2, and 3, respectively. Non-stress-relieved welded boilers and welded-fabricated running-gear frames are the salient features embodied in all three designs.

ELECTRIC LOCOMOTIVES

An experimental industrial-frequency a-c electrification, 48.5 miles in length, was placed in service on the French National Railways. Operating the system with a contact voltage of 20,000 and a frequency of 50 cycles, it is the intention to test and observe performance with several different types of locomotives built by several European manufacturers. One of the locomotives—a series-motored machine with 50-cycle motors—built by Alsthom (France) is described in item 1, Table 2, and illustrated in Fig. 4. Each of the six driving

[1] Report of Committee RR-6, Survey; Chairman, T. F. Perkinson; members, E. R. Battley, F. A. Benger, R. M. Coultas, R. P. Johnson, and F. L. Murphy.

Contributed by the Railroad Division and presented at the Annual Meeting, Atlantic City, N. J., November 25–30, 1951, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

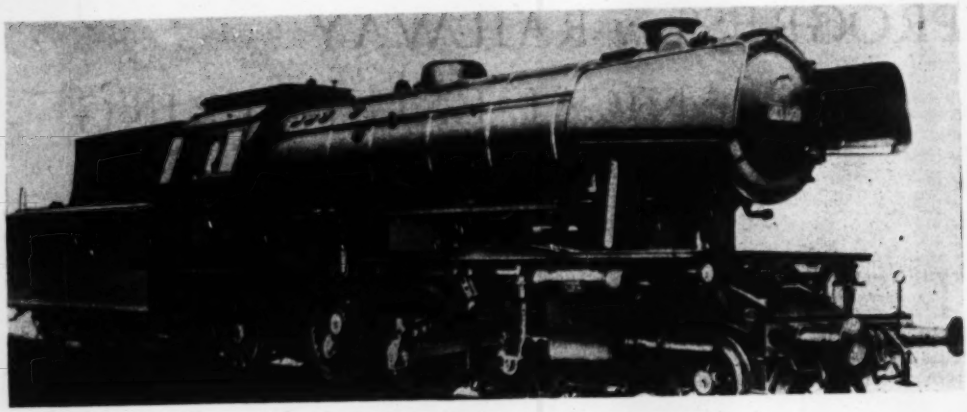

FIG. 1 GERMAN HIGH-SPEED PASSENGER LOCOMOTIVE

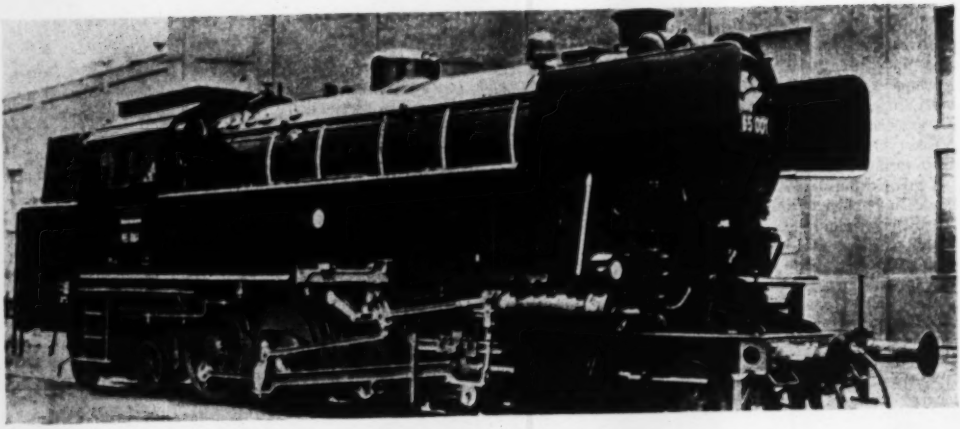

FIG. 2 GERMAN PASSENGER TANK LOCOMOTIVE

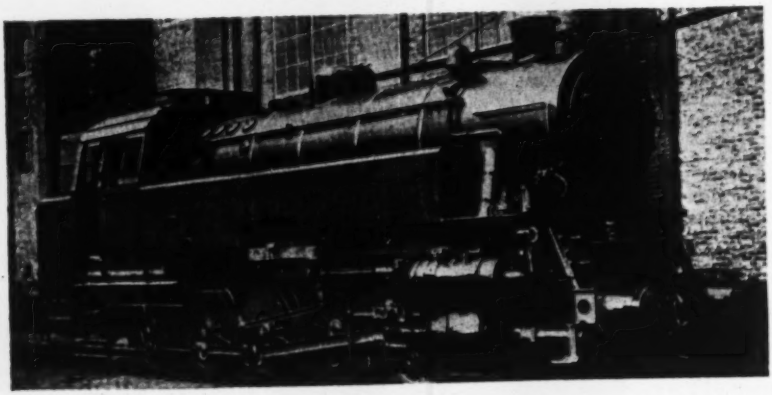

FIG. 3 GERMAN SWITCHING TANK LOCOMOTIVE

TABLE 2 ELECTRIC LOCOMOTIVES

	Item 1	Item 2	Item 3	Item 4	Item 5	Item 6	Item 7	Item 8	Item 9
Railroad	SNCF[a]	SNCF[a]	SNCF[a]	Penna	Penna	Penna	Holland[f]	British Rys	New Zealand
Builder, mechanical	Alsthom[b]	Swiss[d]	Alsthom[b]	Westinghouse	Westinghouse	Gen Elec	Alsthom[b]	British Rys	[h]
Builder, electrical	Alsthom	Oerlikon	Alsthom	Westinghouse	Westinghouse	Gen Elec	Alsthom	Metro-Vick	Eng Elec
Wheel arrangement	C-C	C-C	B + B	2 (B-B-B)	2 (C-C)	2 (B-B)	B-B	B + B	B + B + B
Service	F & P	F & P	F & P	F	F	F	F & P	F & P	F & P
Power supply	20000 kv, a-c	20000 kv, a-c	20000 kv, a-c	11000 v, a-c	11000 v, a-c	11000 v, a-c	1500 v, d-c	1500 v, d-c	1500 v, d-c
Current collector	Pantographs	Pantographs	Pantographs	Pantographs	Pantographs	Pantographs	Pantographs	Pantographs	Pantographs
Driving wheels:									
Number	12	12	8	24	24	16	4	8	12
Diameter, in.	49 1/2	55	49 1/2	44	44	48	49 1/4	50	36 1/2
Weight, lb:									
Total	255000	230000	170000	741000	724000	480000	176370	192640	164000
On drivers	255000	230000	170000	741000	724000	480000	176370	192640	164000
Per driving axle	42000	38333	42500	61750	60330	60000	44090	48160	28000
Dimensions, ft-in.:									
Length over-all	61-5 1/2	56-7	42-4 3/4	124-0	124-0	108-6	42-7 3/16	50-4	62-0
Width over-all	9-9	9-8	9-10	10-5 1/2	10-5 1/2	10-7	9-9 3/8	9-0	8-6
Height, pantograph down	13-11 1/2	...	14-1	15-0	15-0	15-0	13-7 1/16	13-0	11-9
Rigid wheel base	15-5	13-9 1/2	9-8	9-6	16-5	11-0	9-8 3/16	11-6	8-6
Total wheel base	45-8	43-4	29-3	104	...	...	29-4 3/8	35-0	50-0
Traction motors:									
Number	6 twin	6	4	12	12	8	4	4	6
Method of mounting	Suspended	Frame-mounted	Suspended	Axle-hung	Axle-hung	Axle-hung	Spring	Axle-hung	Axle-hung
Method of drive	[c]	Quill	[e]	Gear & pinion	Gear & pinion	Gear & pinion	Quill	[g]	Spur gears
Gear ratio	1/4.83	...	1/4.375	15/68	15/68	1/3.95	1/3.7	17/70	61/17
Tractive forces:									
One-hour rating, lb	37600	39150	28900	198000	198000	76800	23370	25000	22800
Per cent adhesion	14.75	17.0	17	26.8	27.4	16.0	13.2	13.0	13.9
Continuous rating, lb	30000	36000	26900	132000	132000	70800	21600	14600	18000
Per cent adhesion	11.8	15.6	15.8	17.8	18.3	14.75	12.2	7.6	11.0
Horsepower:									
One-hour rating	3810	4175	2780	...	...	5220	2710	1740	1765
Continuous rating	3460	4040	2700	6000	6000	5000	2520	1240	1490
Speed, mph:									
One-hour rating	38	40	36.1	...	...	25.5	43.5	26	29
Continuous rating	43.2	42	37.7	17	17	43.7	43.7	32	31
Maximum speed, mph	62.3	62.5	62.3	63	63	65	84.5	65	60
Regeneration	No	Yes	No	No	No	No	No	Yes	No
Multiple-unit operation	No	No	No	Yes	Yes	Yes	No	No	No
Track gage, in.	56 1/2	56 1/2	56 1/2	56 1/2	56 1/2	56 1/2	56 1/2	56 1/2	42

[a] French National Railways.
[b] Société Générale de Constructions Eléctriques et Mécaniques.
[c] Single spur gear, rigid, quill drive.
[d] Swiss Locomotive and Machine Works.
[e] Single spur gear, rigid.
[f] N. V. Nederlandsche Spoorwegen.
[g] Single-reduction, straight spur resilient gear wheel, solid pinion.
[h] Robert Stephenson & Hawthorns.

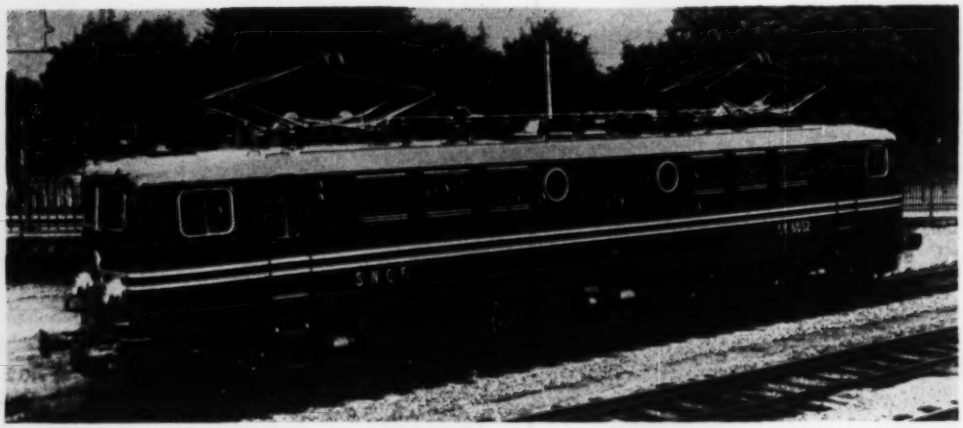

FIG. 4 50-CYCLE 20,000-KV ELECTRIC LOCOMOTIVE

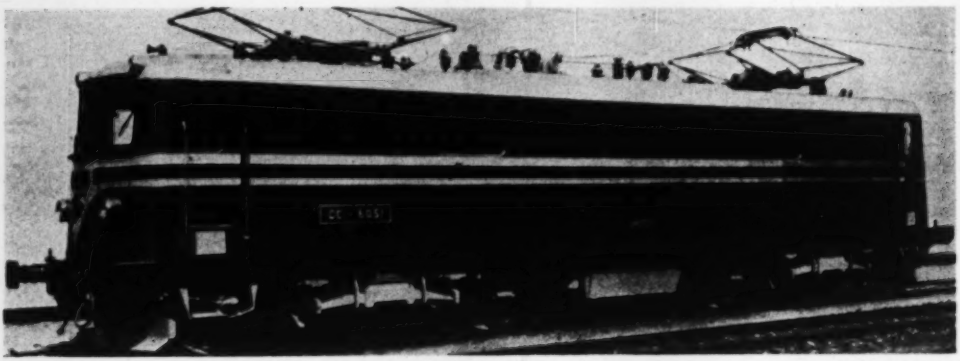

FIG. 5 SWISS-BUILT 50-CYCLE 4300-HP LOCOMOTIVE

axles is equipped with a twin-armature motor, quill-mounted, and driving a single, solid spur gear through an articulated link and rubber flexible drive. A similar locomotive built by the Swiss Locomotive and Machine Works and equipped by Oerlikon (Switzerland), described in item 2, Table 2, and illustrated in Fig. 5, utilizes a single-armature series-wound a-c motor for each of its six driving axles. Both machines are equipped with d-c/d-c motor generator sets to permit operation under a 1500-volt d-c contact system at reduced power outputs.

Figs. 6 and 7, item 3, Table 2, illustrate and describe another experimental design for service on the French Railway's 20,000-volt 50-cycle electrification. The four d-c traction motors are fed by two 1500-volt, six-anode, pumpless, air-cooled, single-phase, full-wave, mercury-arc rectifiers. Control equipment is arranged to permit operation of the locomotive under a 1500-volt d-c contact system.

Westinghouse-Baldwin has delivered two experimental rectifier freight locomotives to the Pennsylvania Railroad. Each locomotive, rating 6000 hp, is composed of two six-axle A-units, operated in multiple, to secure a1 2-driving-axle locomotive weighing approximately 370 tons with all weight on the driving axles. Items 5 and 6 show the principal weights, dimensions, and ratings of the two locomotives which are identical electrically, but differ mechanically.

One locomotive has a 2(B-B-B) wheel arrangement where each A-unit is carried on three interchangeable four-wheel trucks. These trucks, in their general principle of operation, are similar to those used on the Baldwin-Westinghouse gas-turbine locomotive. The outer trucks of each unit are restrained laterally by spring action while the center truck is permitted to move laterally without restraint. The second locomotive having a 2(C-C) wheel arrangement is carried on conventional six-wheel swing-bolster trucks. The two types of running gear were chosen to secure operating experience with each. Should either type show marked superiority, the locomotive cabs are arranged so that all locomotives can be supplied with identical trucks.

The 11,000-volt a-c power from the trolley is reduced to the proper motor voltage by a transformer with variable secondary voltage. In each motor circuit are located two "ignitron" rectifier tubes which convert a-c to d-c for the traction motors. In operation, the control of locomotive speed and output is equally as flexible as that of the conventional a-c locomotive.

Dynamic braking is also provided. During braking, the

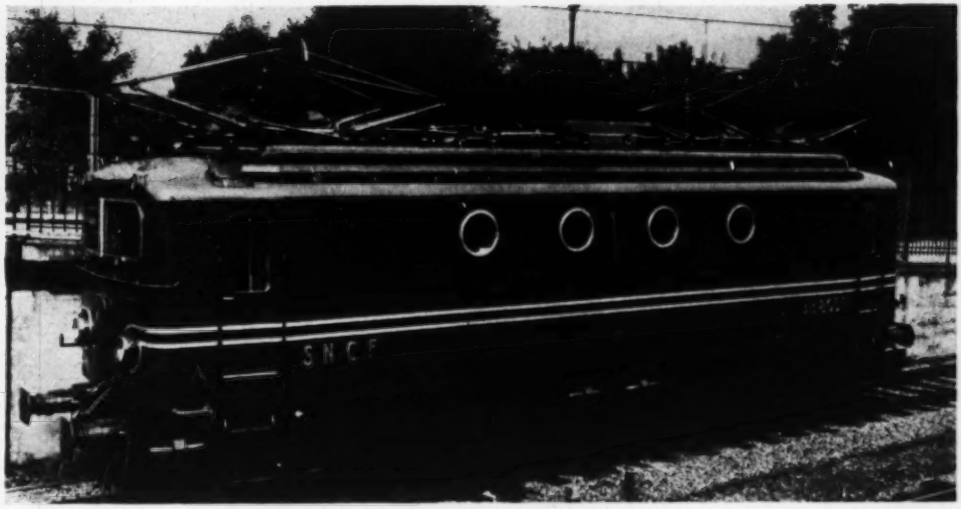

FIG. 6 50-CYCLE RECTIFIER ELECTRIC LOCOMOTIVE

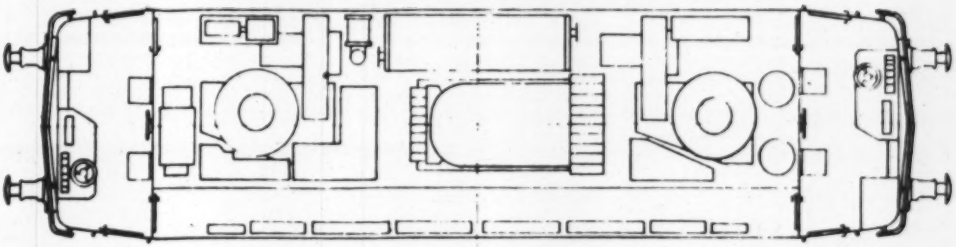

FIG. 7 PLAN FOR LOCOMOTIVE SHOWN IN FIG. 6

excitation for the traction-motor fields is secured from the main transformer and rectified by two of the ignitron tubes.

These two initial locomotives are equipped with rather elaborate electrical filtering apparatus to protect the railroad's communication circuits against disturbances. It is anticipated that service experience will make it possible to reduce or eliminate much of this apparatus.

Salient data covering the two designs are given in items 4 and 5, Table 2; and the locomotive with the 2(B-B-B) wheel arrangement is shown in Fig. 8.

The Pennsylvania Railroad has placed in freight service two two-unit 5000-hp, 11,000-volt, 25-cycle, single-phase electric locomotives built by General Electric, Fig. 9, item 6, Table 2. The mechanical design simulates current Diesel-electric freight-locomotive practice, wherein a streamlined cab is carried on two four-wheel swing-bolster trucks in each of the two duplicate units composing the 5000-hp unit. Nominally rated at 5000 hp, the locomotive will develop 10,600 hp at 25 per cent adhesion for starting. Equipped for rheostatic braking, the locomotive represents the first application of this type of braking in the United States to an electric locomotive carrying a-c series-wound traction motors. Separately excited, the traction motors carry a higher continuous rating as d-c generators during braking than as a-c motors during motoring operations. The two-unit locomotive is rated at 6000-hp in braking over a wide speed range.

In connection with the program of rehabilitating the Netherlands Railways, which suffered extensive damage during World War II, thirty 1500-volt d-c locomotives built in France and described in item 7, Table 2, and shown in Fig. 10, were placed in service.

Item 8, Table 2 and Fig. 11, describe and illustrate a 1500-volt d-c design, 58 of which have been placed in service on the British Railways in territory wherein electrification is being carried out as part of an extensive national program.

Fig. 12 illustrates a B-B-B design in which the cab structure is articulated to eliminate the necessity of span bolsters or spring-loaded weight distribution. The locomotives, built in England, are intended for use on the 42-in-gage lines of the New Zealand Government Railways. Details are given in item 9, Table 2.

DIESEL LOCOMOTIVES

Three of the American builders added to their existing lines six-axled, six-motored, heavy-duty road-switcher Diesel-electrics.

The Baldwin-Lima-Hamilton unit is shown in Fig. 13, in combination with a "booster" unit with identical wheel and

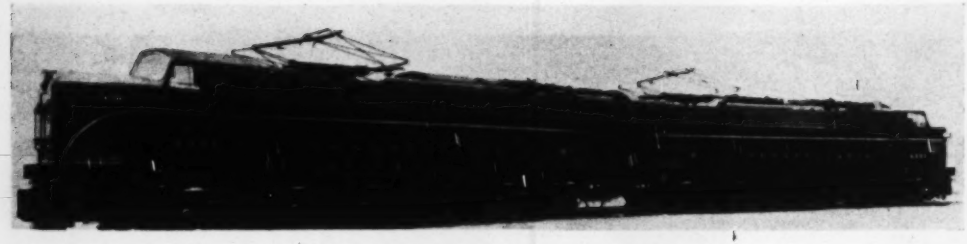

FIG. 8 RECTIFIER LOCOMOTIVE FOR PENNSYLVANIA RAILROAD

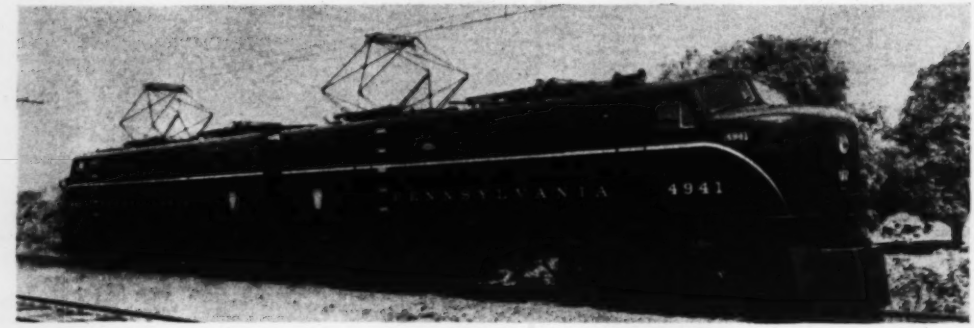

FIG. 9 NEW A-C FREIGHT LOCOMOTIVE FOR PENNSYLVANIA RAILROAD

FIG. 10 ELECTRIC LOCOMOTIVE FOR THE NETHERLANDS

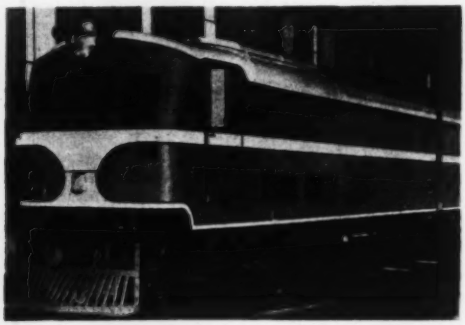

FIG. 12 1500-VOLT D-C LOCOMOTIVE FOR NEW ZEALAND

FIG. 11 BRITISH-BUILT 1500-VOLT D-C ELECTRIC LOCOMOTIVE

TABLE 3 DIESEL LOCOMOTIVES

	Item 1	Item 2	Item 3	Item 4	Item 5	Item 6	Item 7
Builder	B-L-H[1]	Alco-GE	F-M[3]	B-L-H[1]	Davenport[4]	GE	GE
Owner	[2]	[2]	[2]	[2]	CRI&P[5]	Venez[7]	C. Rica[8]
Wheel arrangement	2(C-C)	C-C	C-C	2(B-B)	B-B	C + C	B-B
Service	F	RS	General	F	RS	RS	RS
Engine data:							
Engines per cab	1	1	1	1	2	2	1
Engine hp rating	1600	1600	1600	800	500	450	660
No. of cylinders	8	V-12	8	6	V-12	V-12	6
Bore and stroke, in.	12 3/4 × 15 1/2	9 × 10 1/2	8 1/2 × 10	12 3/4 × 15 1/2	5 3/4 × 8	5 3/4 × 8	9 × 10 1/2
Engine speed, rpm	625	1000	850	625	1200	1200	1000
Cycles	4	4	2	4	4	4	4
Supercharged	...	Yes	...	...	Yes	Yes	Yes
Manufacturer	B-L-H	Alco	F-M	B-L-H	Cat[6]	Cat[6]	C-B[9]
Weight on drivers, lb	750000	325000	360000	480000	220000	136400	130000
Total loco weight, lb	750000	325000	360000	480000	220000	136400	130000
Fuel capacity, gal	3800	800	800	1300	625	400	500
Driving wheel diam, in.	42	40	42	40	40	33	33
Type of drive	Electric	Electric	Electric	Electric	Electric	Electric	Electric
Track gage, in.	56 1/2	56 1/2	56 1/2	56 1/2	56 1/2	42	42
Maximum permissible speed, mph	60	60	70	60	60	40	35

TABLE 3 (*continued*)

	Item 8	Item 9	Item 10	Item 11	Item 12	Item 13	Item 14
Builder	[10]	Australia	SLM[12]	Eire[14]	British[16]	[16]	Whitcomb
Owner	Br Rwys[11]	Australia	FE[13]	Eire	Br Rwys[11]	Br Rwys[11]	—
Wheel arrangement	1-C-C-1	B-B	A1A-A1A	B-B	B-B	2-D-2	B
Service	F&P	S	F	F&P	F&P	F&P	S
Engine data:							
Engines per cab	1	1	1	1	1	4	1
Engine hp rating	1600	800	675	915	675	500	240
No. of cylinders	16	8	6	6	V-16	12	6
Bore and stroke	10 × 12	10 × 12	9 7/8 × 11 7/8	280 mm × 360 mm	7 × 7 3/4	7 × 7 3/4	5 1/8 × 6
Engine speed, rpm	750	750	750	750	1250	1500	1800
Cycles	4	...	4	4	...	...	4
Supercharged	Yes	Yes	Yes	...	Yes	Yes	..
Manufacturer	Eng Elec	...	SLM[12]	Sulzer[15]	Paxman[17]	Paxman[17]	Cummins
Weight on drivers, lb	246350	193000	73480	179200	156160	171000	80000
Total loco weight, lb	303750	193000	110000	179200	156160	270000	80000
Fuel capacity, gal	1150	600	320	420	330	720	100
Driving wheel diam, in.	43	44	33 3/8	44	42	51	33
Type of drive	Electric	Electric	Electric	Electric	Electric	Hydraulic	Hydraulic
Track gage, in.	56 1/2	56 1/2	39 3/8	63	56 1/2	56 1/2	56 1/2
Maximum permissible speed, mph	...	21	56	55	70	78	30

NOTES:

1 Baldwin-Lima-Hamilton Corp.
2 Various railroads.
3 Fairbanks, Morse & Company.
4 Davenport-Besler Corp.
5 Chicago, Rock Island & Pacific Railroad.
6 Caterpillar Tractor Company.
7 Venezuela State Railways.
8 Cia Bananera de Costa Rica (United Fruit).
9 Cooper-Bessemer.
10 Derby Locomotive Works, London Midland Regions, British Railways.
11 British Railways.
12 Swiss Locomotive & Machine Works.
13 Franco-Ethiopian Railway.
14 Coras Iompair Eireann.
15 Sulzer Bros., Ltd.
16 North British Locomotive Company, Ltd.
17 Davey, Paxman & Company, Ltd.

FIG. 13 DIESEL-ELECTRIC LOCOMOTIVE WITH NONOPERATING 1600-HP BOOSTER UNIT

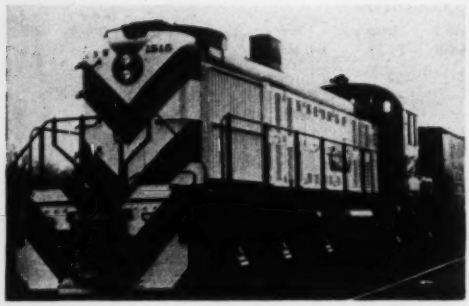

FIG. 14 SIX-MOTOR DIESEL-ELECTRIC ROAD SWITCHER

FIG. 17 TWIN-ENGINE 1000-HP SWITCHER LOCOMOTIVE

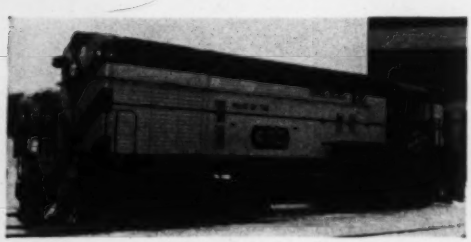

FIG. 15 SIX-MOTOR 1600-HP ALL-PURPOSE UNIT

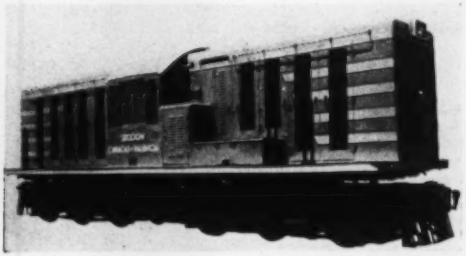

FIG. 18 68-TON 900-HP NARROW-GAGE UNIT FOR VENEZUELA

FIG. 16 DIESEL-ELECTRIC SWITCHER WITH NONOPERATING 800-HP BOOSTER UNIT

motor arrangement. The booster unit of this locomotive is utilized when operating over a heavy-grade section and is detached at either end of the grade to be picked up by the next locomotive proceeding in the opposite direction. Data on these units are given in item 1, Table 3.

Item 2, Table 3, describes the new six-motored, six-axled, 1600-hp road switcher added to the Alco-GE line of Diesel-electrics and Fig. 14 shows a typical unit of this design.

The Fairbanks-Morse C-C design is shown in Fig. 15 and described under item 3, Table 3. The unit shown weighs 288,000 lb, but the design can be furnished with total weight as high as 360,000 lb.

Another booster unit built by Baldwin-Lima-Hamilton for use with a standard 800-hp four-axle unit is shown in Fig. 16, and salient data are given under item 4, Table 3.

Davenport-Besler has introduced a two-engine, 1000-hp, 110-ton switching-transfer unit as shown in Fig. 17, details of which are given under item 5, Table 3. The unit carries two Caterpillar V-8 engines running at 1200 rpm, equipped with mechanically driven scavenging blowers for supercharging.

A group of eight 68-ton locomotives with unusually low weight per horsepower was built for service on a 42-in-gage line in Venezuela by General Electric. Two 450-hp Caterpillar engines, supercharged, are included. Data are given in item 6, Table 3, and the locomotive, with a C-C running gear, is shown in Fig. 18.

A narrow-gage (42-in.) version of the standard-gage General Electric 70-ton, 660-hp switcher powered with a Cooper-Bessemer engine is described under item 7, Table 3.

British Railways engineers continue to experiment with large power Diesel units for British main-line passenger and freight service. The 1947–1948 report of this committee carried a description of a 1600-hp unit with a C-C wheel arrangement, employing a non-weight-bearing centering arrangement and four load-bearing pads in each of the two trucks. A similar design of 1600-hp unit, except for the use of a 1-C-C-1 running gear, was introduced into service during the past year. Details of the latter unit are given in item 8, Table 3, while a photograph is shown in Fig. 19. The inclusion of an idling axle in each of the two trucks is dictated by axle-loading limitations rather than by any running qualities observed in the earlier C-C model.

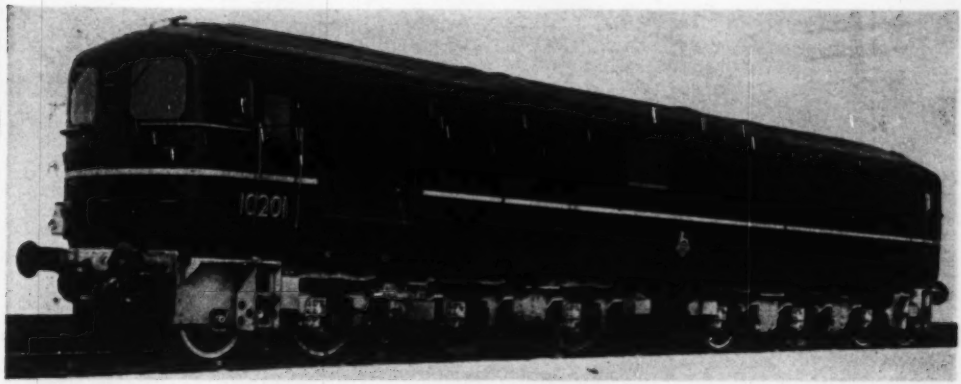

FIG. 19 BRITISH-BUILT 1600-HP PASSENGER LOCOMOTIVE

FIG. 20 AUSTRALIAN 800-HP SWITCHING UNIT

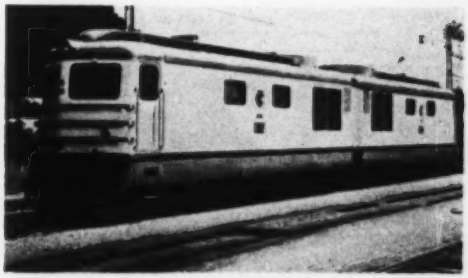

FIG. 21 SWISS-BUILT 675-HP LOCOMOTIVE FOR ETHIOPIA

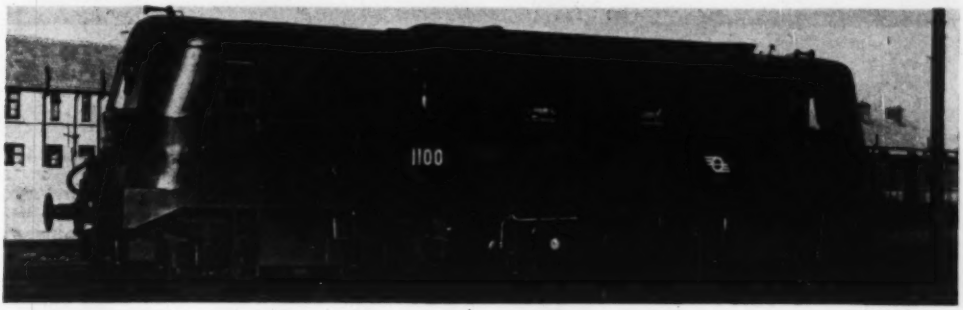

FIG. 22 915-HP FREIGHT AND PASSENGER LOCOMOTIVE FOR EIRE

Fig. 20 illustrates an 800-hp unit built for standard-gage ($56\frac{1}{2}$ in.) operation in Australia by Commonwealth Engineering, Ltd., of Australia, embodying engine and electrical equipment built in England. Item 9, Table 3, describes this unit.

SLM and Brown-Boveri (Switzerland) have furnished 12-meter-gage, 500-hp Diesel-electric units for service on the Franco-Ethiopian Railway in Africa (Fig. 21, item 10, Table 3). Individual axle loading for this line currently is restricted to a maximum of 20,000 lb, necessitating an A1A-A1A running gear for initial operation of the unit. The truck is so designed that when the line has been overhauled to permit axle loadings of 26,000 lb, the idle axle in each truck can be removed, thus enabling the locomotive to operate with all weight on a B-B running gear.

A new line of locomotives has been built in Eire, which is described in item 11, Table 3. Equipped with Metropolitan-Vickers electrical equipment, one of these units is shown in Fig. 22.

A new locomotive intended for branch-line and local train

FIG. 23 675-HP FREIGHT AND PASSENGER LOCOMOTIVE FOR BRITISH RAILWAYS

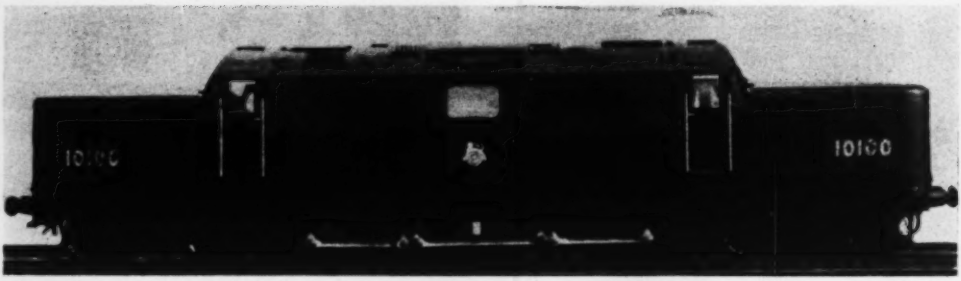

FIG. 24 FOUR-ENGINE 2000-HP DIESEL LOCOMOTIVE EMPLOYING HYDRAULIC DRIVE

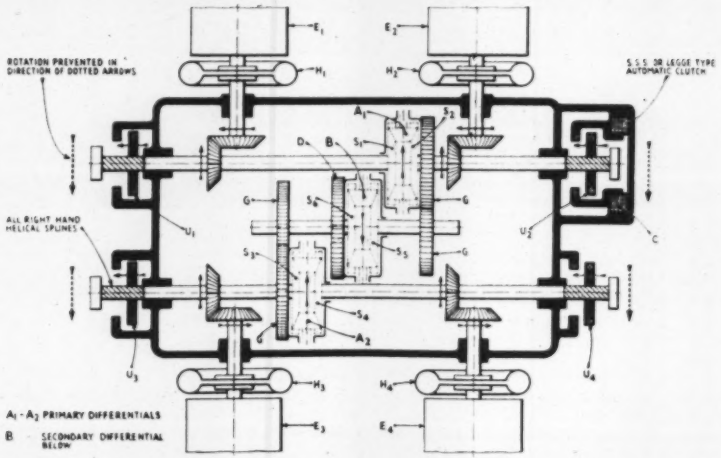
ROTATION PREVENTED IN DIRECTION OF DOTTED ARROWS
S.S.S. 30 LEGGE TYPE AUTOMATIC CLUTCH
ALL RIGHT HAND HELICAL SPLINES
A1 - A2 PRIMARY DIFFERENTIALS
B SECONDARY DIFFERENTIAL BELOW

FIG. 25 DIFFERENTIAL DRIVE TO GEARBOX OF LOCOMOTIVE SHOWN IN FIG. 24

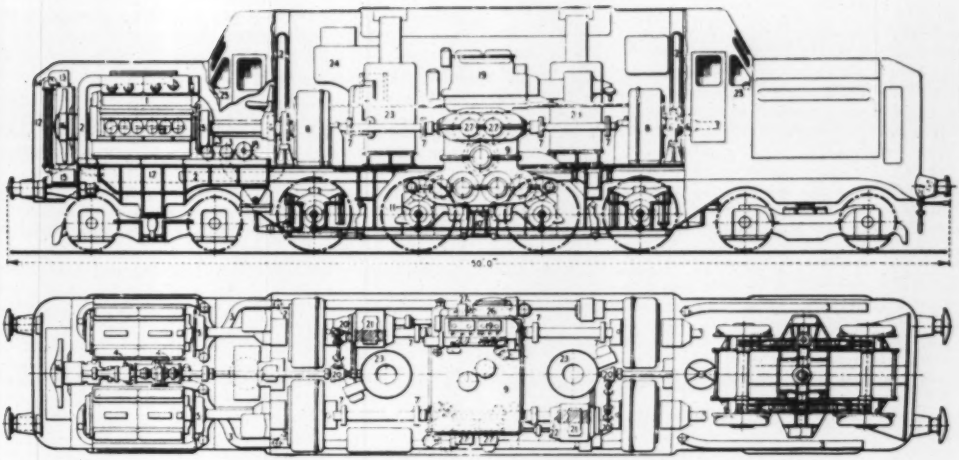

FIG. 26 EQUIPMENT LAYOUT OF LOCOMOTIVE SHOWN IN FIG. 24

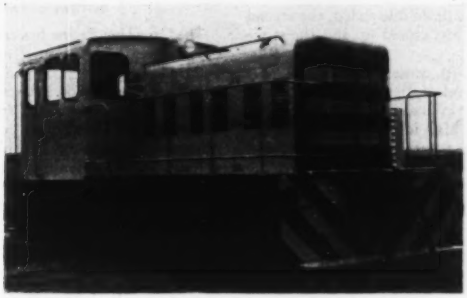

FIG. 27 HYDRAULIC-DRIVE 240-HP DIESEL SWITCHER

services, comparable to the American road-switcher designs, has been delivered to the British Railways. Built by the North British Locomotive Company, Ltd., the electrical equipment was furnished by British Thomson-Houston Company, Ltd. Illustrated in Fig. 23, this locomotive is described in item 12, Table 3.

A Diesel locomotive of novel design has been placed in experimental service on the lines of the British Railways. Fig. 24 shows an over-all view of the unit, while Fig. 25 illustrates several of the novel features of design. Outstanding in the design are the number of engines employed—four 500-hp engines for traction and two 150-hp engines for auxiliary services. The four traction engines drive into a single gearbox through individual hydraulic couplings, and the control is arranged to bring in and cut out each of the engines individually. The traction engines are relatively highly pressure-charged at their lowest speeds and progressively less highly pressure-charged as their speed increases, in order to provide a high torque characteristic at low locomotive starting speeds. Pressure-charging is supplied from blowers driven by the two auxiliary engines, the speed of which is governed under control of the main-engine charging pressure. The gearbox contains a combination of differential-gear sets by means of which locomotive acceleration, running, and reversal are accomplished with gears always in mesh. A general machinery layout is shown in Fig. 26. Item 13, Table 3, shows the equipment layout of the unit.

Fig. 27, item 14, Table 3, describes a 40-ton Diesel-hydraulic unit built by Whitcomb, employing a "twin-disk" hydraulic torque converter, a two-speed gear-change transmission, and an axle-hung reverse-gear and final-drive transmission which is mounted on the rear axle. Power is transmitted between axles by means of roller chains.

GAS-TURBINE LOCOMOTIVES

Operation of the General Electric gas-turbine-electric locomotive was concluded after 20 months of revenue freight service over the Union Pacific System. At the end of March the locomotive had operated 105,732 miles, including operation on the manufacturer's test track and on the Nickel Plate, Pennsylvania, and Union Pacific. It had consumed 1,797,426 gal of fuel oil of which about 95 per cent was heavy oil, and produced 363,816,000 gross-ton-miles. The greater part of this mileage was in freight service on the Union Pacific in all types of service and operating conditions. The over-all fuel con-

sumption on the Union Pacific was 4.2 gal per 1000 gross-ton-miles and the average train was 3635 tons whereas, for the last two months on the U.P., in territory more adapted to the application characteristics of the locomotive, the fuel consumption was 3.51 gal per 1000 gross-ton-miles, and the average train, 3810 tons. Availability figures for these months varied from 0 to as high as 95 per cent for various reasons, which was expected with such a developmental unit.

During this test operation the locomotive exhibited extraordinarily good adhesion characteristics. Early predictions that the locomotive would be slippery because the horsepower per axle exceeded the usual 500 hp found on conventional Diesel-electric locomotives, were not substantiated. In fact, the locomotive proved to be exactly the opposite and, toward the end of the operation, tonnage ratings were applied based on adhesion figures about 10 per cent higher than those commonly employed for Diesel-electric-locomotive applications. Reasons cited for the improved adhesion characteristics include better starting ability available on account of the 20-notch control, good weight-shifting characteristics, and electrical circuit arrangements.

Fuel consumption per 1000 gross-ton-miles varied, depending upon the type of service and the operating terrain. The fuel economy is better in high-load-factor service than in low. Consequently, the locomotive is best adapted for hauling heavy through-freight rather than for services involving large amounts of idling or low-power operation.

Although the locomotive was built double-ended, the second operating cab was not used. It was closed up and the space was used for extra fuel capacity.

No problem was encountered with noise. Tests prove that the full-load power-plant noise level of the gas-turbine-electric locomotive is about the same as or even a little lower than that of Diesel engines. The relatively high idling noise level is not regarded as detrimental since the power plant is started and stopped easily.

Tunnel operation was originally approached with some concern but tests indicated that such operation was no more of a problem than with Diesel-electric and steam locomotives.

During the year, the Baldwin-Westinghouse gas-turbine locomotive underwent extensive tests at the Westinghouse East Pittsburgh Works, operating with various types of residual fuel oils. Following these shop tests, the locomotive operated in passenger and freight service on the Pittsburgh and Lake Erie Railroad, using residual oil fuel. This road operation indicated the desirability of certain changes, primarily in the fuel system and control apparatus. These modifications are now being made, and after completion the locomotive will be returned to service for further operating experience.

Development work, aimed at the production of a coal-burning gas-turbine-electric locomotive, continues under the direction of the Locomotive Development Committee of Bituminous Coal Research, Inc., at the Dunkirk, N. Y., plant of the American Locomotive Company. A full-scale test equipment incorporating an Allis-Chalmers 4200-hp compressor-turbine set, with traction and auxiliary generators, and a complete coal-handling—preparation, combustion, and ash-separation—assembly has been erected within the geometry of a two-cab locomotive. Life tests on turbine blading subjected to the gas flow secured in this system are currently under way.

Under sponsorship of the Department of Mines and Resources of Canada, an experimental coal-burning turbine installation is being erected at McGill University in Montreal. This installation will employ the exhaust-heated cycle in which the heat is supplied to the system by burning fuel in the turbine exhaust. The heat thus generated is transferred to compressed air in a heat exchanger located between the compressor and the turbine. Thus the products of combustion in this system do not come into direct contact with the turbine blading.

Experimental work aimed at the use of coal for gas turbines is also reported from England.

STEAM-TURBINE LOCOMOTIVES

Development work on the Norfolk & Western Railway Company's 4500-hp coal-burning steam-turbine-electric locomotive, being built by the Baldwin-Lima-Hamilton Corporation, is proceeding satisfactorily. Delivery is scheduled for the fourth quarter, 1952. This locomotive is designed for freight service, and has a water-tube boiler producing steam at 600 psi and 900 F temperature. Steam from the boiler will drive an impulse-type turbine, which will operate a d-c generator through reduction gears. A traction motor will be provided on each of the 12 axles. Westinghouse will furnish the electrical equipment. The boiler, built by Babcock & Wilcox, has undergone extensive acceptance tests.

The specifications for the locomotive have been revised to include a 6-6-6-6 wheel arrangement, dynamic braking, an enlarged tender with a water capacity of 22,000 gal, and other minor changes to suit the railway's operating conditions. The locomotive will weigh, including tender, about 1,062,600 lb, and the over-all length between coupler faces will be approximately 161 ft $1\frac{1}{4}$ in. Coal capacity is 20 tons carried in the compartment ahead of the operator's cab.

ROTARY SNOW PLOW AND MELTER

The Canadian Pacific has taken delivery of a combined rotary snow plow and snow melter built by the William Bros Boiler and Manufacturing Company. The unit consists of a large steel tank mounted on a flatcar which also incorporates, at the forward end, rotary rakes and chute for picking up and discharging snow and which points in any direction or into the snow-melting tank. The unit is pushed by a steam locomotive which also furnishes steam used for heating and melting snow. The rotating feeder-rake is mounted on a horizontal shaft so that it may be raised and lowered through an arc starting within 3 in. of the rail and reaching to 8 ft above rail level. Behind the rake is a double-V-mold board with a V over each rail. In each V and mounted also on a horizontal shaft is a 42-in. rotary wheel for gathering and discharging the snow that is broken up and thrown back by the rake. The adjustable discharge chutes are of the revolving type which permit the snow to be cast in any direction or to the melting tank.

The plow is powered by a heavy-duty 300-hp Diesel engine. The operator's cab is functionally designed to permit complete visibility. The cab controls for operating the plow mechanism are actuated hydraulically.

MULTIPLE-UNIT CARS

A new design of 25-cycle a-c multiple-unit car equipment, using a truck-mounted motor driving each of four axles, and a resistance acceleration-control system operated by a motor-driven cam controller, was introduced in the Pennsylvania's commuter train service. Self-contained gear units are semi-permanently axle-mounted in roller bearings while the motor, driving the gear unit through a flexible splined shaft, is completely truck-mounted in rubber.

PASSENGER CARS

Passenger-car purchasing and building during the past year were at the lowest levels since 1941. During the 12 months up to July 1, a total of 475 passenger cars were built in the United States for domestic railroads and for export. As of the first of July, there was a backlog of 298 passenger cars on order in the United States, including 80 cars for export.

In the past year the Great Northern Railroad placed in service a new 15-car "Empire Builder" train, operating on a 45-hr schedule between Chicago and the Pacific Northwest. This is the second new "Empire Builder" that the Great Northern has placed in service since the war—the first having had its inaugural run in 1947. The sleeper cars and the observation cars in the new train were built by Pullman-Standard Car Manufacturing Company. The coaches, diners, coffee shops, and head-end cars were built by American Car and Foundry. All cars incorporate interior treatment characteristic of the northwest country. Mechanical improvements dictated by experience with the first Empire Builder were incorporated.

The Santa Fe added a Pullman-Standard-built dome car to each of the "Super-Chiefs," deluxe Chicago-Los Angeles trains. These dome cars are operated adjacent to the diner and include a lounge section at one end and introduce at the other end a new and unusual feature in railroad cars. This room, called the "Turquoise Room," because of the decorative theme, is normally a cocktail lounge, but is readily converted to a private dining room for special parties, served from the kitchen in the adjoining car. The dome overhead has four coach seats, each seating two passengers and eight parlor-car seats, a novel arrangement giving maximum comfort and visibility.

The Southern Pacific installed new streamlined "Sunset Limiteds" built by Budd, operating between New Orleans and the West Coast. These cars utilize the Budd disk-type brake. The cars also use design and decorative features typical of the southwestern territory.

Early in 1951 the Budd Company delivered to the Burlington Railroad the first of thirty new suburban cars called the "Gallery" car. These cars have a center entrance and a unique two-level structure, giving a seating capacity of 148 passengers. On the first or lower level of the car, which is approximately 10 in. lower than the normal car floor level, a total of 96 passengers are seated in double seats on either side of a central aisle. Galleries on either side of the car over the double seats each contain a narrow aisle for passage, and a single seat adjacent the upper level windows seats 52 passengers. The upper aisles are reached by short stairways, one at either side of the car and one at either side of the double center-entrance doors.

The cars are built of stainless steel, are 85 ft in length, but to allow for the gallery are 15 ft-8 in. high, 2 ft 2 in. higher than the conventional lightweight car. The cars are air-conditioned for summer comfort; winter heating is thermostatically controlled. Individual incandescent lights are provided above each seat. Fig. 28 illustrates the upper and lower seating arrangement as well as the stairway.

FIG. 28 DOUBLE-DECK SUBURBAN PASSENGER CAR

FREIGHT CARS

Since the first of July, 1950, production of freight cars in the United States has increased from an average of 1200 cars a month in the first half of 1950, to nearly the goal of 10,000 cars a month in June, 1951. As of the end of June, 1951, there was a backlog of freight-car orders placed with car builders and railroads of 150,020 cars. Shortage of steel is, and probably will continue to be, the limiting factor in freight-car production for the next year.

The Pressed Steel Car Company introduced a new type of freight car based upon a new principle of design utilizing wood for the entire structure of the car. This car is known as a Unicel car and is shown in Fig. 29. It is stated that the car is a functional cell or unit, which derives its strength from its shape, and that the cellular construction used is the same as that used in airplane design.

The underframe, sides, ends, and flat roofs are built up in individual subassemblies. Each subassembly, except the ends, utilizes a cellular wood or egg-crate construction with a covering of laminated plywood on either side. To attain maximum

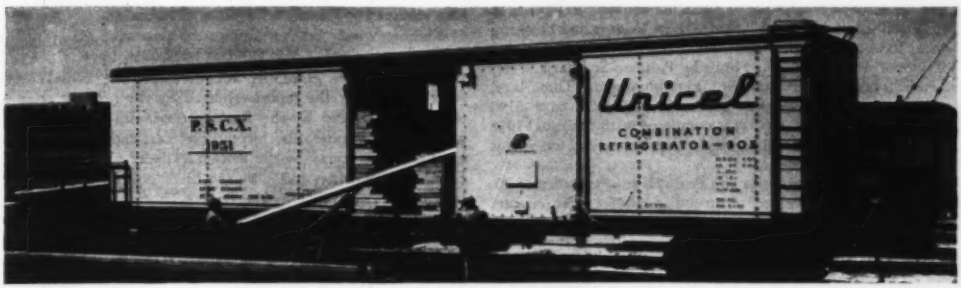

FIG. 29 UNICEL COMBINATION REFRIGERATOR AND BOXCAR

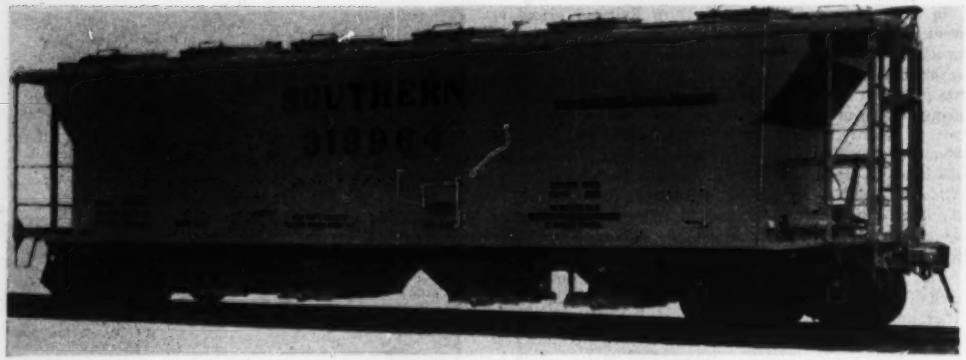

FIG. 30 COVERED-HOPPER CAR FOR SOUTHERN RAILWAY

strength in the ends, a plywood inner and outer facing is bonded to a solid core of vertical wood members, which in turn have been rigidly bonded side by side to one another.

The plywood used in these cars is made in 4-in-wide sections with joints formed by lapping the multiple thicknesses in such a manner as to form essentially a continuous sheet the entire length of the structure. The exterior surface of the plywood used on the sides and roof has a wear-resistant phenolic-impregnated fiber on the face of the panel giving a surface of plastic, which is invulnerable to weather, water, or even boiling.

No center sill is used on these cars, but a solid laminated bolster and draft-gear yoke has been designed. A steel plate bolted to the underside of the laminated-wood bolster forms a means of attachment for the center plate. A floating draft sill, including a rubber draft-gear assembly, floats within the laminated-wood draft-gear pocket.

The six subassemblies—sides, roofs, floors, and ends—are assembled by special curved laminated members which fit into and are bonded to the overlapping plywood skin of each of the subassemblies. Sides, roofs, floors, and ends are to be fabricated as one-piece stressed-skin subassemblies in a series of 1000-ton hydraulic presses. New-type radio-frequency heating is to be used to heat and fuse these laminated assemblies.

A combination boxcar has been built, demonstrated, and subjected to some laboratory tests. Road tests are now being conducted on test cars.

Means of protecting lading against damage is still being given concentrated study by manufacturers and railroads. A number of designs of strap anchors, used at door and intermediate posts for attachment of bonding irons to secure the lading, have been introduced in the past year. Several new loading and blocking devices have also been brought out.

The Southern Railway had built by Pullman-Standard 70-ton covered hopper cars for handling aluminum ore. These cars, because of the light density of the ore handled, have 3190 cu ft capacity and six hoppers, as compared with the usual 1958 cu ft and four hoppers. The inside length is 40 ft 2 in. versus 29 ft 3 in. (Fig. 30).

Pullman-Standard built for the Pennsylvania an order of 70-ton 52-ft 6-in. all-welded drop-end gondolas. These cars have an all-steel floor.

The Canadian National also built during the past year 100 covered hopper cars with 3000 cu ft capacity. These cars were built with high-tensile low-alloy steel and have the side posts welded to the inside of the side sheets to aid in increasing the capacity. The car is divided into four compartments, with two hoppers for each compartment, one on either side of the car. Each hopper is provided with a vibrator casting suitable for an electric vibrator.

The Canadian National received from the National Steel Corporation 100 longitudinal hopper cars 47 tons capacity. They are primarily for company service in ballasting, but also can be used for hauling bulk commodities such as coal. They are designed to release ballast from a moving train to the sides or center of the track, free of the rails and in quantities as desired by the operator. There are four hoppers arranged longitudinally, each hopper having two doors, hinged along the center line of each hopper. Four doors are arranged to dump inside and four arranged to dump outside the track.

The New York Central received four special high-capacity flat and well-type cars in June of this year. The first, a 44-ft flatcar, has a cast-steel underframe and two cast-steel trucks at each end of the car, these trucks being connected by span bolsters. This car has a lightweight of 98,700 lb and a load limit of 500,300 lb. There are two 67-ft 6-in. depressed-center cars, also having cast-steel underframe and four 4-wheel cast trucks. These cars have a 25-ft depressed center section 2 ft $4^1/_4$ in., above the rail and have a load limit of 342,100 lb. The lightweight is 159,900 lb. These three cars were built in the Merchants Despatch Shops.

The fourth is a well-type flatcar, with all-welded open-hearth-steel construction, built by Greenville Steel Car Company. This car uses Buckeye 6-wheel freight-car-type trucks at either end. It weighs 115,000 lb and has a load limit of 261,400 lb. This car has a well opening between trucks 7 ft, 8 in. wide and 35 ft long.

ACKNOWLEDGMENT

The Committee gratefully acknowledges the assistance in securing data for the report rendered by the railway press of the United States; by the *Railway Gazette* of Great Britain; by the various railroads, locomotive, car, and railway-equipment manufacturers; by the British Railways; by the English Electrical Company, Ltd.; by the Metropolitan Vickers Electrical Company, Ltd.; by the British Thomson-Houston Company, Ltd.; by the French National Railways; by the Société Générale de Constructions Eléctriques et Méchaniques; by the Brown-Boveri Corporation; by the Coras Iompair Eireann; by the Netherlands Railways; and by the Swiss Locomotive and Machine Works.

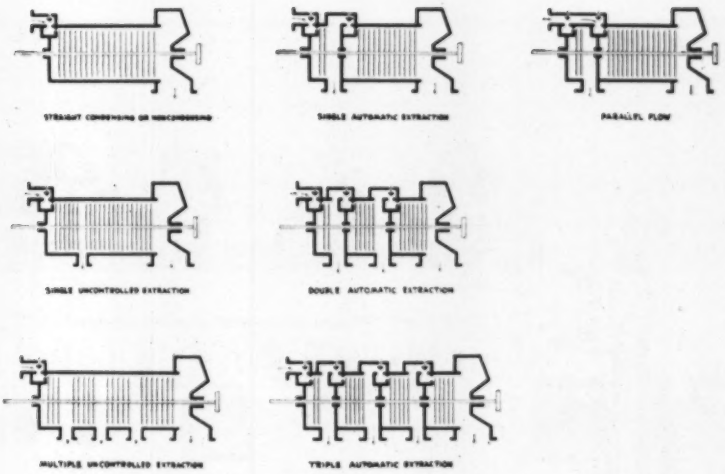

FIG. 1 TYPES OF TURBINES BY APPLICATION

Development of PROCESS STEAM TURBINES *for* INDUSTRY

By A. D. SOMES

STEAM TURBINE ENGINEERING DIVISION, GENERAL ELECTRIC COMPANY, RIVER WORKS, WEST LYNN, MASS. MEMBER ASME

MANY industries use large quantities of heat, as well as large amounts of power, for processing their products. Steam is a convenient medium for transferring large quantities of heat to process; (*a*) water is generally available, (*b*) it is nontoxic, (*c*) it is relatively noncorrosive to commonly available materials, (*d*) the specific-heat content is high, (*e*) most of the heat is released at constant temperature, (*f*) the temperature of the medium in the process can be controlled easily by controlling pressure, and (*g*) it is re-usable with the residual heat content where not contaminated by the process.

By generating steam at a pressure above the process level and using the expansive energy in a turbine, power can be produced at a very low incremental fuel rate. The large economic gains obtainable from combining the need for power and process steam have led to the development of a wide variety of steam turbines to supply both uses. These are commonly referred to as "process-steam turbines," and power produced from the process steam is known as "by-product power."

Fig. 1 shows schematically various types of steam turbines. The straight-noncondensing, single automatic-extraction, double automatic-extraction, triple automatic-extraction, and parallel-flow turbines have been developed as a result of applications to industrial processes.

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Fig. 2 is a shaded cross section of one arrangement of a double automatic-extraction turbine.

The chemical and paper industries have recognized the benefits of by-product power and make extensive use of such equipment. A modern paper mill, using chemical pulp, well illustrates the quantities involved. About 22,000,000 Btu of heat and 800 kwhr of power are required per ton of output. A mill of 1200 tons per day production uses about 1100 million Btu per hr, and has a power load of about 40,000 kw.

Steam is generally used for processing at two pressure levels; at about 160 psig in the digesters, and at about 50 psig for drying in the paper machines and for liquor recovery. For this 1200-ton mill, about 300,000 lb per hr of steam will be used at the 160-psi level, and 800,000 lb per hr of steam at the 50-psi level, with a total of 1,100,000 lb per hr. By selecting suitable operating conditions and equipment, this steam can be made to supply nearly all of the power required at an incremental fuel rate less than one half the fuel rate obtainable by other means.

Where steam must be generated to serve the needs of the process, by-product power can be made by a process turbine at an additional fuel consumption of approximately 4250 Btu per kwhr as compared with 11,500 Btu per kwhr for prime power in an equivalent plant. Where a reasonable balance exists between the plant power requirements and the power available from the process steam, the plant power requirements can be obtained at a very low cost compared with firm power.

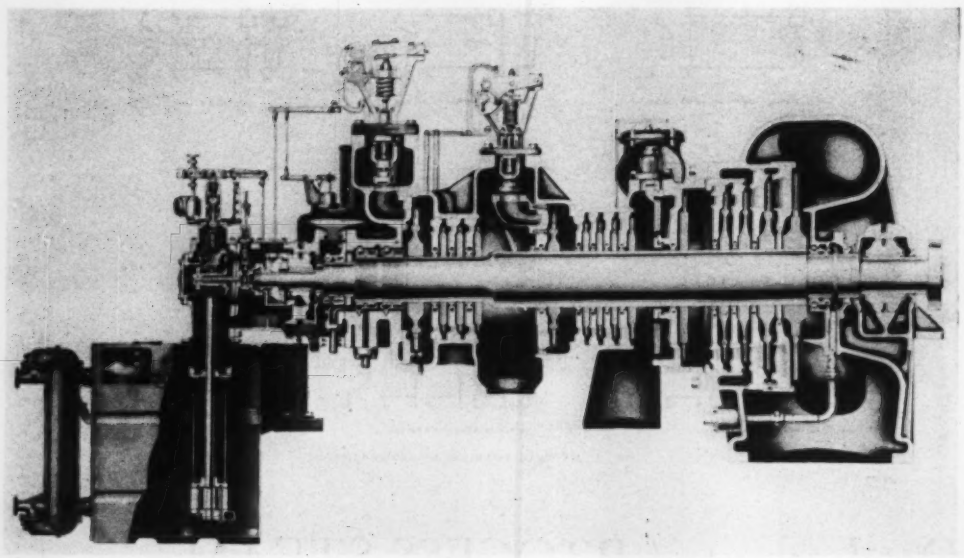

FIG. 2 STEAM TURBINE OF TYPICAL DOUBLE AUTOMATIC-EXTRACTION DESIGN

The plant investment, is of course, increased because of the use of the higher pressure and temperature equipment, but the increased cost per kilowatt of capacity is generally only a fraction of the cost of prime generating equipment.

APPLICATION OF PROCESS TURBINE

In application, the process turbine becomes an integral part of the processing plant. In fact, there is a trend today to lay out plants with large process-steam needs in straight-line units; boilers; turbines for process-steam by-product power and firm power; and product-processing equipment. Reserve equipment is not provided as the reliability of modern boilers and turbines is high, and outages from other causes are frequent enough to provide for necessary maintenance.

The elementary process turbine takes steam at the generated pressure and temperature, and exhausts it at a pressure close to that required by the process. This may be at any pressure above or below atmosphere so long as the pressure is lower than the generated pressure. At one extreme, it may be exhausted at high vacuum to a condenser serving as a water heater. At the other extreme, it may be exhausted at pressures in the 800-psig range or even higher. By proper selection of the initial conditions, steam can be exhausted at almost any condition ordinarily used for processing.

Basically, the turbine accommodates itself to the steam flows required by the process, while extracting as much power as practical. The flow through the turbine must balance exactly the process requirements. This could be accomplished by a regulating valve in the steam line ahead of the turbine, controlled by the pressure in the process line at the turbine exhaust. In effect, it would operate as a pressure-controlled reducing valve, with the major portion of the pressure drop utilized in the turbine to produce power. The combination is the simple single throttling-valve control frequently used on small turbines.

Multiple sectionalized-nozzle control valves give improved efficiency and increased output from the turbine at flows below the designed power, as compared with the single throttling control valve. This is illustrated in Fig. 3. To take advantage

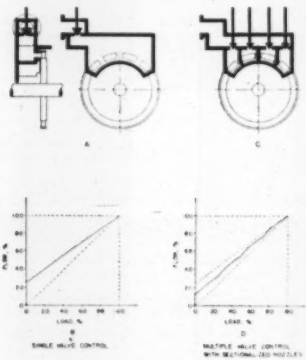

FIG. 3 CONTROL-VALVE ARRANGEMENT

of the multiple-valve arrangement, the pressure-control mechanism operates on the sectionalized valves, which are an integral part of the turbine. The turbine functions both as a pressure-controlled reducing valve and a machine for producing by-product power.

The power output of the simple process turbine fluctuates with the process-steam flow, and seldom matches the power requirements of the plant. At times, the power output from the process steam may exceed the plant power requirements.

The excess power must be utilized elsewhere or the steam flow through the turbine may be limited to the power demand, with the additional steam for the process made up by a separate reducing valve from the boiler. The turbine valves then operate to balance the power demands instead of the process-steam demands.

Smooth transition of the control function from one to the other on the more complicated extraction turbines is an important feature in limiting trip-outs during plant disturbances, and contributes much to the dependability of modern process turbines.

Generally, the power requirements exceed the output available from the process steam with normal operating conditions, and the additional power must be made up from other equipment. Most large industrial plants, producing large amounts of by-product power, also make their own firm power. The close relation of the power equipment and product equipment makes direct control essential.

The topping turbine, exhausting to the steam supply for existing power-generating equipment, is a special form of process turbine where the immediate product is power. In the more complex forms of process turbines, such as the automatic-extraction turbine, the topping duty may become inseparably mixed with the normal process operation.

In some plants it happens that steam is made available beyond any process needs at that pressure level from some part of the process, such as waste-heat boilers or exhaust from other process turbines. This steam may be used in a process turbine exhausting to a lower process pressure or to a condenser. Alternatively, the steam may be inducted into another turbine in the reverse operation of extraction. In fact, most automatic-extraction turbines can be modified to take in a limited amount of steam in this manner by rather simple changes.

While an independent process turbine and power-balancing turbine are often used, the two can be combined effectively into a single unit to form an automatic-extraction turbine or a parallel-flow turbine. In industrial plants, the automatic-extraction turbine is the most frequently used type. The extraction process turbine and the extraction turbine producing by-product power from process steam along with firm power are both used either separately or in combination.

TURBINE COMBINATIONS

The advantages of combining the several elements into a single unit are (*a*) lower cost, (*b*) less space, (*c*) reduced losses, (*d*) higher average output with widely varying flows, (*e*) co-ordinated and simplified control, and (*f*) less hazard of outages.

The relation of the basic process turbine operating with a power-balancing turbine to the parallel-flow or extraction-type turbine is shown in Fig. 4. The simplest combination would be to couple the shaft of a process turbine to the shaft of a power-producing turbine with a common load connection for the two as shown in Fig. 4(B). The steam flow through the process turbine would be controlled to match the process demand, and the power-producing turbine would be controlled to balance the total output with the load. The speed of the process turbine is automatically established by the speed of the power-producing turbine through the common shaft connection. There are cases where this arrangement is the most desirable.

It is less costly to combine the two turbines into a single casing with the flow divided to pass through each machine in parallel as shown in Fig. 4(C). The arrangement is referred to as a "parallel-flow machine." Where the process-steam flow ranges from zero to the maximum the machine will handle, it may give more average output than other arrangements.

Both the process turbine and the power turbine must be made large enough to take the maximum range of process-steam flow and power. When the process turbine is operating with full-flow and output, the load-balancing turbine has a reduced load on it. When the process turbine is operating with a low flow and output, the power-balancing machine has high output. It will be seen that the load conditions on the two machines change in opposite directions so that at least one machine is always operating at an unfavorable efficiency condition due to part load on it.

Combining the process turbine with the corresponding upper stages of the power-producing turbine, as shown in Fig. 4(D), permits that group of stages to operate with less widely varying flows and at a higher average flow. The combined arrangement is referred to as an "automatic-extraction turbine," and is characterized by having a set of control valves, known as extraction valves, in the mid-portion of the turbine controlling the flow through the lower stages. These valves co-operate with the control valves at the main inlet to supply the process steam demands simultaneously at the required process pressure and to allow sufficient flow to pass through the lower stages of the turbine to meet the load requirements.

Double and triple automatic-extraction turbines are further developments of the principle applied to the single automatic-extraction turbine where process steam is used at two or three pressure levels. A single turbine may be used to supply steam at all levels, or various combinations of turbines may be used in parallel to supply the different levels.

DATA FOR TYPICAL PROCESS-STEAM PLANT

By way of illustration, assume a plant requiring process steam at three different pressure levels below the steam-generation pressure, set up as follows:

(*a*) Steam is generated so that it is available at 1250 psig and 950 F.

(*b*) Process steam is required at three levels—425 psig, 160 psig, and 70 psig.

(*c*) A condenser capable of producing 2 in. Hg absolute pressure is available for condensing steam for the production of firm power.

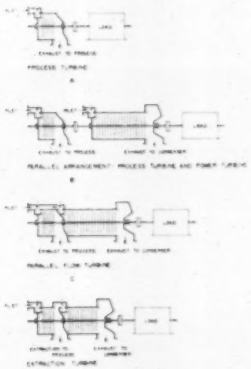

FIG. 4 TYPES OF PROCESS TURBINES

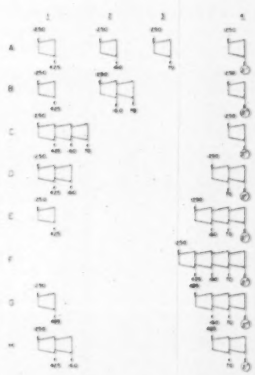

FIG. 5 PROCESS-TURBINE ARRANGEMENTS

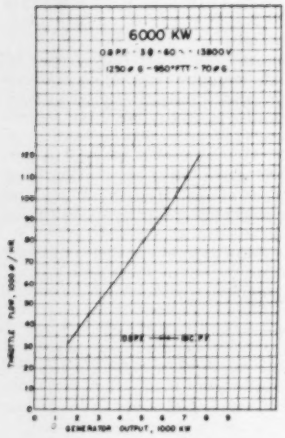

FIG. 6 PERFORMANCE FOR STRAIGHT NONCONDENSING TURBINE

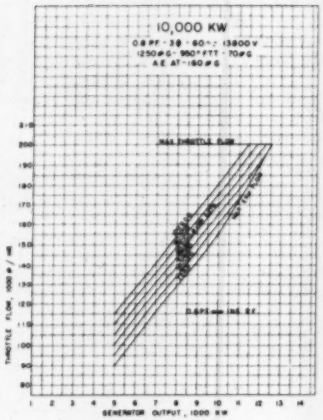

FIG. 7 PERFORMANCE CURVE FOR SINGLE AUTOMATIC-EXTRACTION TURBINE

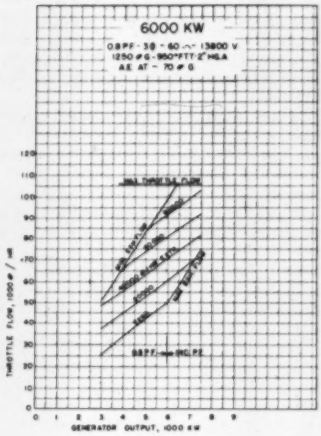

FIG. 9 PERFORMANCE CURVE FOR SINGLE AUTOMATIC-EXTRACTION TURBINE

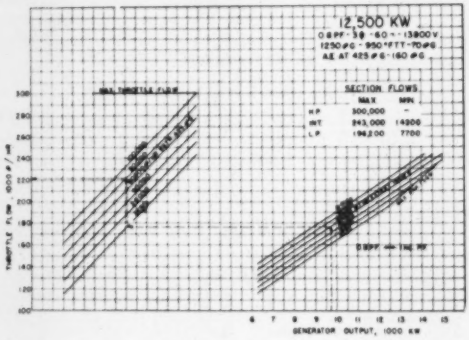
12,500 KW
0.8 PF - 3Φ - 60 ~ - 13800 V
1250 # G - 950 # TT - 70 # G
A.E. AT 425 # G - 160 # G
SECTION FLOWS
MAX MIN
H.P 300,000 -
INT 243,000 14300
L.P 194,200 7700
MAX THROTTLE FLOW
THROTTLE FLOW, 1000 # / HR
GENERATOR OUTPUT, 1000 KW

FIG. 8 PERFORMANCE CURVE FOR DOUBLE AUTOMATIC-EXTRACTION TURBINE

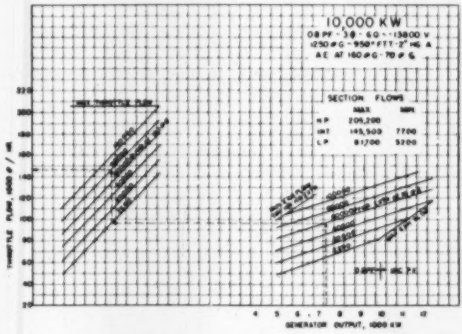
10,000 KW
0.8 PF - 3Φ - 60 ~ - 13800 V
1250 # G - 950 # TT - 2" HG A
A.E. AT 160 # G - 70 # G
SECTION FLOWS
MAX MIN
H.P 209,200 -
INT 149,500 7700
L.P 81,700 5200
MAX THROTTLE FLOW
THROTTLE FLOW, 1000 # / HR
GENERATOR OUTPUT, 1000 KW

FIG. 10 PERFORMANCE CURVE FOR DOUBLE AUTOMATIC-EXTRACTION TURBINE

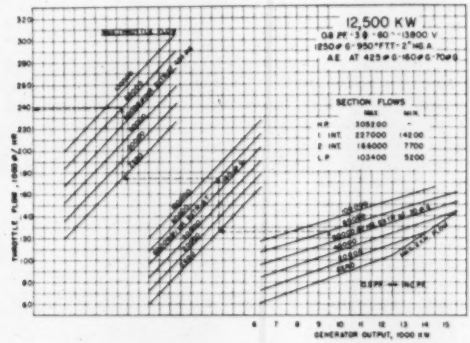
12,500 KW
0.8 PF - 3Φ - 60 ~ - 13800 V
1250 # G - 950 # TT - 2" HG A
A.E. AT 425 # G - 160 # G - 70 # G
SECTION FLOWS
MAX MIN
H.P 305200 -
I. INT. 227000 14200
2. INT. 164000 7700
L.P 103400 5200
THROTTLE FLOW, 1000 # / HR
GENERATOR OUTPUT, 1000 KW

FIG. 11 PERFORMANCE CURVE FOR TRIPLE AUTOMATIC-EXTRACTION TURBINE

Fig. 5 shows some of the more common arrangements in use. Each line of this figure is a way to accomplish the result. Other combinations are practical and many are in use.

Figs. 6 to 11, inclusive, show typical performance curves for turbine-generator units corresponding to the various turbines shown in Fig. 5. The maximum process steam to be supplied at each pressure is 100,000 lb per hr. Ratings have been selected suitable to the output from the 100,000-lb per hr process steam demand at each pressure used simultaneously.

TABLE 1 TURBINE DATA

Fig. no.	Type of turbine	Reference Fig. 5	Rating, kw	Pressure: Inlet psig	Extraction 1 Psig	Extraction 2 Psig	Extraction 3 Psig	N.C. Psig	Exhaust, cond., in. Hg, abs
6	Straight-noncondensing.....	A3	6000	1250	—	—	—	70	—
7	Noncond., single auto. extr..	B2	10000	1250	160	—	—	70	—
8	Noncond., double auto. extr..	C1	12500	1250	425	160	—	70	—
9	Cond., single auto. extr.....	D4	6000	1250	70	—	—	—	2
10	Cond., double auto. extr.....	E4	10000	1250	160	70	—	—	2
11	Cond., triple auto. extr.....	F4	12500	1250	425	160	70	—	2

Table 1 describes the turbines and references the corresponding types shown in Fig. 5.

Methods for estimating the performance of different types of turbines have been published.[1]

Most process turbines drive alternating-current generators with their output in the form of electric power. Several turbine-generator units are easily operated in parallel electrically. All are locked together through the electrical connection, and operate at the same speed as effectively as though the turbines were connected mechanically. The use of turbine-generator units allows greater flexibility in operation and design. Subsequent discussion will be based upon turbine-generator units with alternating-current generators.

The simple process turbine exhausting to a process line operates basically to pass just enough steam to balance the process demand. Constancy of pressure is the direct indication of the degree of balance, and departure from the set value regulates the operation of the turbine control valves through a pressure governor. The output of the machine varies with the flows. Since speed is dependent upon the balance between system output and load, it must be held by equipment free to control output. The process turbine floats in the line and feeds in power as it is produced from the process flow.

FUNCTIONS OF AUTOMATIC-EXTRACTION TURBINES

The single automatic-extraction turbine supplying process steam from the extraction opening, and firm power from the steam passing through the exhaust, has two basic functions.

With changes in extraction flow at constant output, the difference in flow through the section of the turbine above the extraction point and the flow through the section below must be changed without altering the output of the turbine and the pressure in the extraction stage. The output will remain constant when the flow through the section above the extraction opening and the flow through the section below are changed in opposite directions so that the power changes in the two sections are equal and opposite, with the extraction pressure unchanged. Therefore the inlet and extraction valves must move in opposite directions in response to departures from the set extraction pressure with the rates of change in the flows close to a definite ratio.

With the changes in load on the machine at constant extraction flow, the flow through both sections must be changed in the same direction to produce an equal change in output without altering the difference in flow through the two sections, the pressure in the extraction stage, and the speed. Therefore the inlet and extraction valves must move in the same direction in response to departures from the set speed with the rates of change of flow through the two sections very closely equal.

Fig. 12 shows a simplified turbine and automatic-extraction control mechanism for a single extraction turbine with speed governor and extraction pressure governor that satisfy the fundamental control requirements.

The double automatic-extraction turbine adds another variable, a second extraction flow, requiring control.

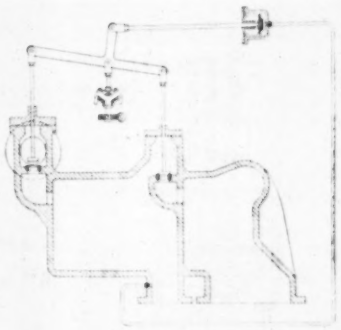

FIG. 12 VERTICAL SECTION OF SINGLE 3-ARM EXTRACTION MECHANISM FOR STEAM TURBINE

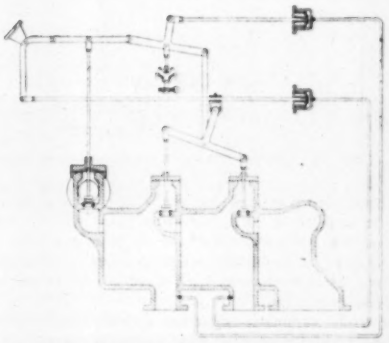

FIG. 13 SCHEMATIC DIAGRAM OF DOUBLE 3-ARM VALVE MECHANISM FOR STEAM TURBINE

[1] "Modern Turbine," edited by L. E. Newman, John Wiley & Sons, Inc., New York, N. Y., 1944.

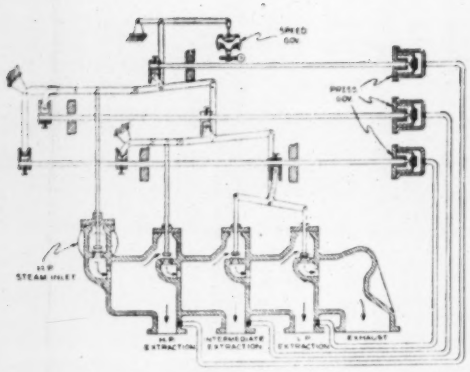

FIG. 14 TRIPLE 3-ARM VALVE MECHANISM

The basic mechanisms shown in Figs. 12 and 13, amplified with suitable hydraulic oil relays, are widely used today. The basic mechanism of Fig. 14 has been used similarly on a triple automatic-extraction turbine now nearing completion. Liberal travels and position restoring of the hydraulic relays gain high sensitivity, accuracy, stability, and flexibility in adding supplementary control functions. Incorporation of the third 3-arm for the triple extraction control was a simple extension of the double extraction-control mechanism used extensively since 1934.

DIVISION OF ELECTRICAL LOAD AND PROCESS STEAM

Any number of units with the different types of turbine shown in Fig. 5 can be operated together on the steam side as well as electrically. Modern governing mechanisms permit simultaneous division of electric load and process steam between the machines. The division may be proportioned according to a prescribed plan.

In the case of multiple-extraction machines, preference may be given to selected process demands as the capacity limits at each extraction point are reached. For example, the double-extraction machine E4 in Figs. 5 and 10, can be arranged to satisfy the 70-psig process demand in preference to the 160-psig process demand or vice versa when operation approaches a condition where the process-steam demands are more than enough to develop the electrical load on it.

A simple transition situation can be seen by considering the operation of the single automatic-extraction turbine covered by the performance curve in Fig. 9 with a sudden drop in load

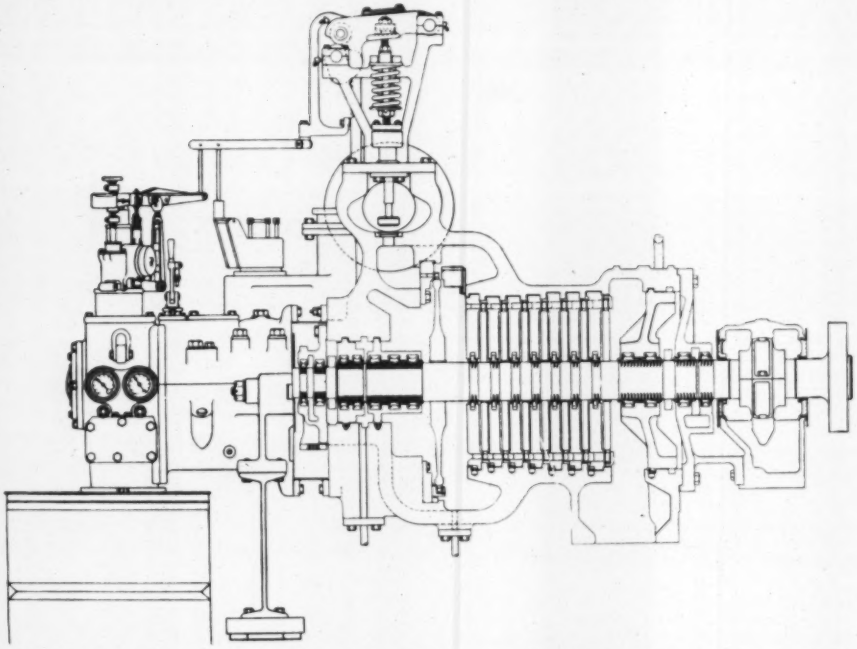

FIG. 15 , 5000-KW STRAIGHT NONCONDENSING TURBINE FOR INLET STEAM AT 900 PSIG 750 F AND EXHAUST AT 200 PSIG

The conditions outlined for the single extraction turbine must be satisfied at each extraction point without altering the conditions applying to load and the other extraction point. Fig. 13 shows a simplified turbine and double automatic extraction-control mechanism with speed governors and extraction pressure governors.

The triple automatic-extraction turbine adds yet another variable, a third extraction flow, requiring control. Fig. 14 shows a simplified turbine and triple extraction-control mechanism with speed governor and pressure governors.

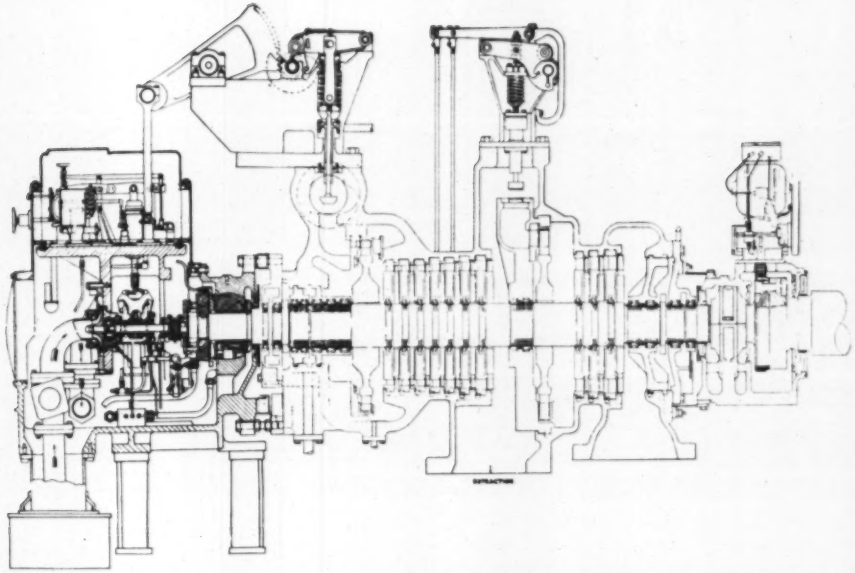

FIG. 16 12,500-KW SINGLE AUTOMATIC-EXTRACTION NONCONDENSING TURBINE FOR INLET STEAM AT 850 PSIG 825 F AND EXHAUST AT 75 PSIG; EXTRACTION IS AT 175 PSIG

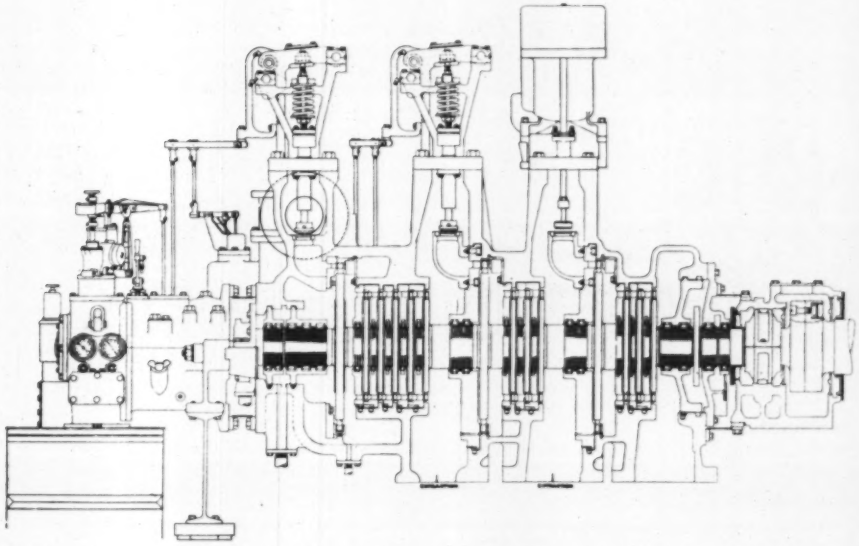

FIG. 17 7500-KW DOUBLE AUTOMATIC-EXTRACTION NONCONDENSING TURBINE FOR INLET STEAM AT 900 PSIG 870 F AND EXHAUST AT 125 PSIG; EXTRACTION IS AT 425 PSIG AND 235 PSIG

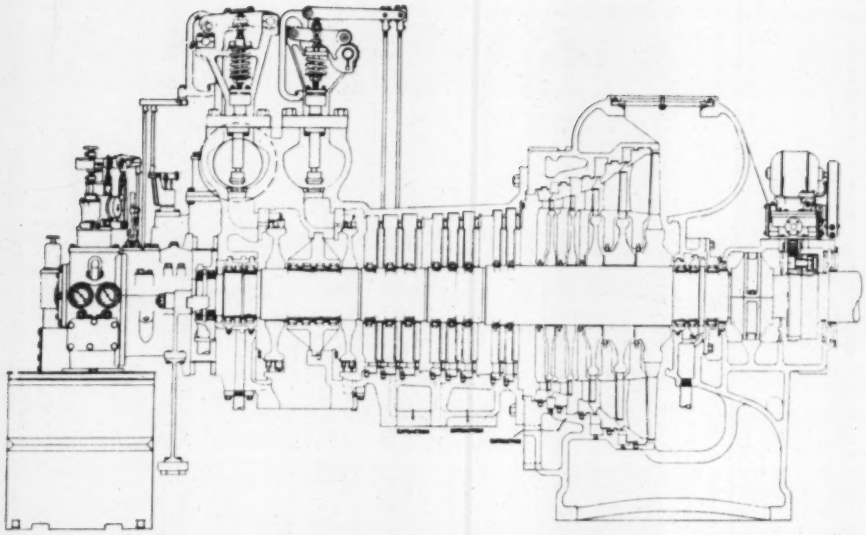

FIG. 18 10,000-KW PARALLEL-FLOW CONDENSING TURBINE WITH PROVISION FOR THREE STAGES OF FEEDWATER HEATING FROM CONDENSING END

(Inlet steam is at 800 psig 725 F and exhaust to condenser at 1.5 in. Hg abs; exhaust from noncondensing section is at 280 psig.)

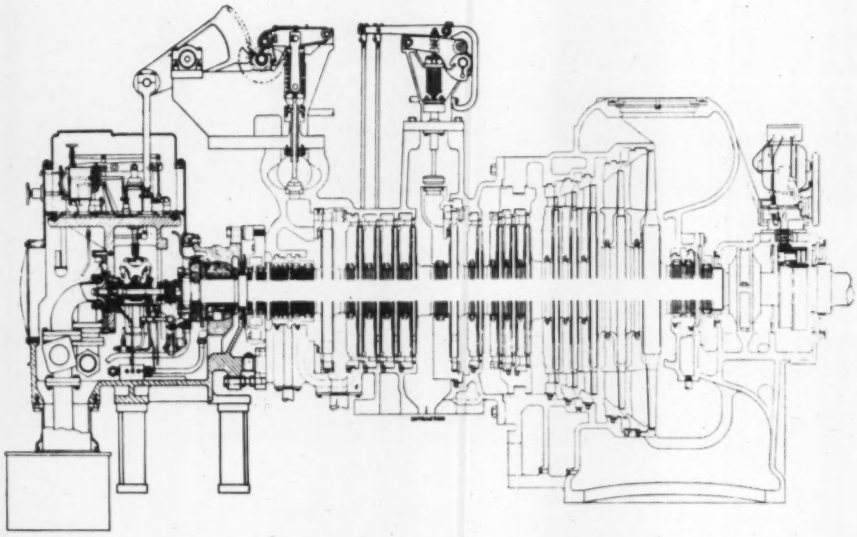

FIG. 19 15,000-KW SINGLE AUTOMATIC-EXTRACTION CONDENSING TURBINE FOR INLET STEAM AT 825 PSIG 825 F AND EXHAUST AT 1.5 IN. HG ABS; EXTRACTION IS AT 200 PSIG

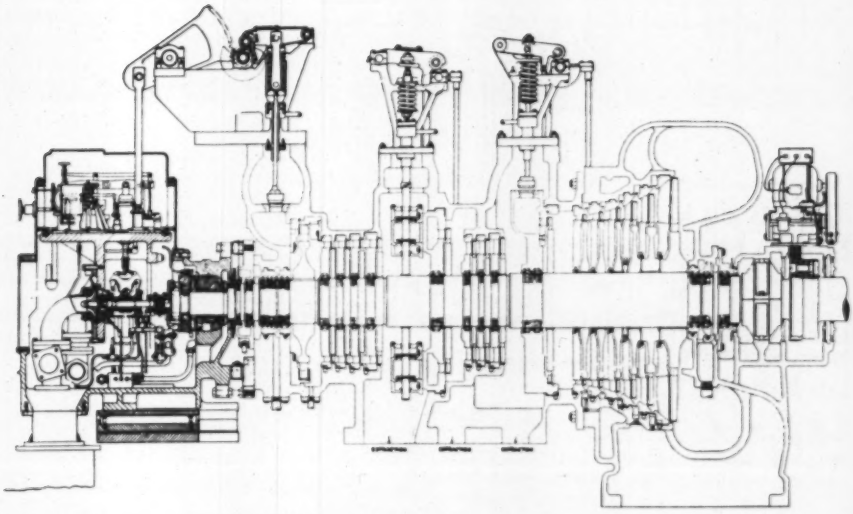

FIG. 20 10,000-KW DOUBLE AUTOMATIC-EXTRACTION CONDENSING TURBINE FOR INLET STEAM AT 850 PSIG 825 F AND EXHAUST AT 2.5 IN. HG ABS; EXTRACTION IS AT 175 PSIG AND 75 PSIG

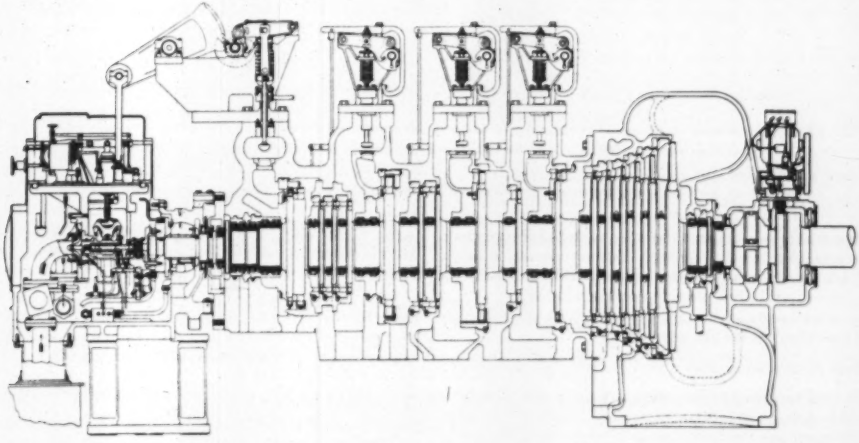

FIG. 21 10,000-KW TRIPLE AUTOMATIC-EXTRACTION-ADMISSION CONDENSING TURBINE FOR INLET STEAM AT 1200 PSIG 950 F AND EXHAUST AT 2 IN. HG ABS; STEAM IS ADMITTED AT 400 PSIG, AND EXTRACTED AT 150 PSIG AND 80 PSIG

due to a plant disturbance when operating with a sustained process-steam demand from the extraction opening. Consider a drop in load from 7000 kw output with a constant extraction of 80,000 lb per hr. Operation moves down the 80,000-lb per hr extraction line until minimum flow to the exhaust is reached at 5250 kw output. At lower loads, operation moves down the line of minimum exhaust flow. Above 5500 kw, the inlet flow to the machine changes by 7.7 lb per kwhr, the incremental steam rate along the 80,000-lb per hr extraction line. Below 5250 kw, the inlet flow changes by 15.3 lb per kwhr, the incremental steam rate along the minimum exhaust flow.

With a normal speed governor, the regulation is doubled along the minimum exhaust-flow line. Other units operating in parallel will drop disproportionate amounts of load. Frequently one machine completely unloads and is disconnected from the electrical system.

Modern governing mechanisms are designed to change regulation under such conditions and continue to divide load normally.

The triple-extraction machine shown in Fig. 11 has four different incremental steam rates with average values of 6.4, 13.6, 16.6, and 30.5 lb per kwhr, respectively. The rate for

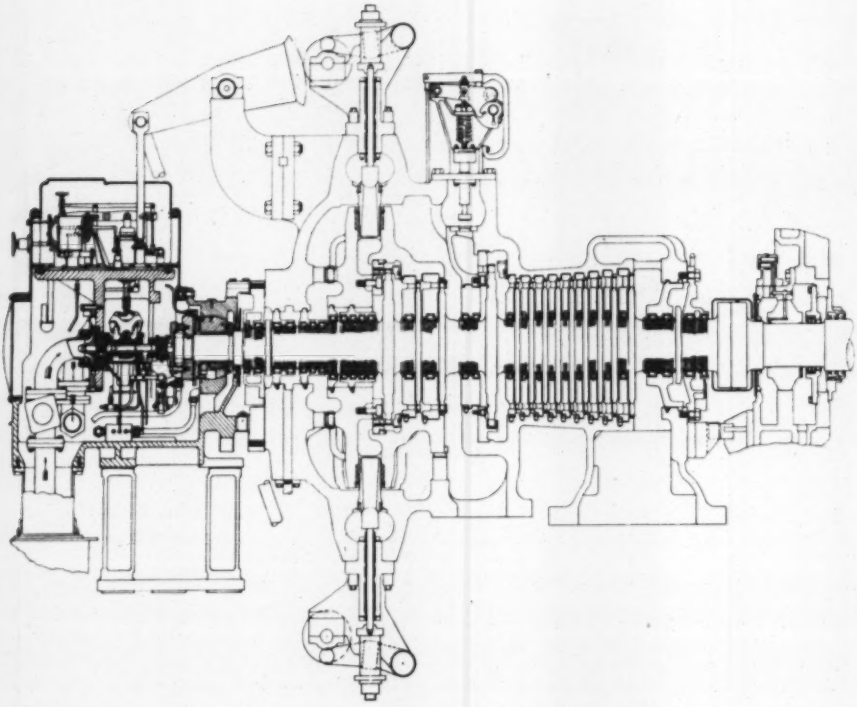

FIG. 22 15,000-KW SINGLE AUTOMATIC-EXTRACTION-ADMISSION NONCONDENSING TURBINE FOR INLET STEAM AT 1250 PSIG 950 F AND EXHAUST AT 75 PSIG; STEAM IS EXTRACTED AT 600 PSIG OR ADMITTED AT 590 PSIG

(This machine is designed with double casing and with valves in both top and bottom. In this respect, it follows practice used by author's company on machines for central-station service handling comparable flows at these pressures and temperatures.)

the high-pressure section from the inlet to the 425-psig extraction point is 4.8 times the rate with constant extraction flows. The governing mechanisms can change regulation selectively as each limit is reached to permit normal regulation.

Many other control functions can be accomplished readily to meet special industrial-plant problems.

TYPES OF AUTOMATIC-EXTRACTION TURBINES AVAILABLE

Single automatic-extraction turbines were in use as early as 1914, and double automatic-extraction turbines in 1925. The first triple automatic-extraction turbine will be put in service in 1951. This machine is actually arranged for the induction of steam at the upper point and will operate normally with steam being passed into the machine rather than extracted.

Lest there be any misconception about the triple automatic-extraction turbine, it should be noted that this type of machine will prove economically practical only for quite unusual plant conditions.

Steam-generation pressures and temperatures in industrial power plants have increased steadily over the years. By 1930, 400 psig 750 F was common for new power-plant equipment with a few applications at 600 psig 800 F. By 1940, 600 psig 825 F was common for new plants with a few up to 850 psig 850 F.

Today, 900 psig 900 F is generally acceptable, with the larger plants going to 1200 psig 950 F. Some are considering 1800 psig 1000 F, but the present situation with critical materials probably will restrict use of these conditions.

Figs. 15 to 22, inclusive, are cross sections of process turbines built by the author's company and selected by the author as examples of the various types of turbines discussed. With the exception of the triple automatic-extraction turbine, Fig. 21, and the single automatic-extraction-admission noncondensing turbine, Fig. 22, which are now under construction, these represent machines in service and operating successfully.

These turbines are indicative of the types used in industrial power plants for generating by-product power. Machines in larger and smaller sizes are available and in service. Details vary, of course, with the size of the machine as well as the pressures, temperatures, and process-steam flows. The more complicated double and triple automatic-extraction turbines are not economically practical in small ratings.

Among the larger machines in service is a 15,000-kw double automatic-extraction condensing turbine with inlet steam at 440 psig 750 F and exhaust at 2 in. Hg abs. Extraction is at 175 psig and 40 psig. Two 40,000-kw single automatic-extraction condensing machines are in operation, and two more are under construction. Inlet steam is at 1250 psig 950 F and exhaust at 1.5 in. Hg abs. Extraction is at 475 psig.

PLASTICS LITERATURE REFERENCES

Selected for the Mechanical Engineer—July 1950 Through June 1951

By GORDON B. THAYER

PLASTICS TECHNICAL SERVICE, THE DOW CHEMICAL COMPANY, MIDLAND, MICH.

THIS is a brief review of plastics literature references which have been selected to be of interest to the mechanical engineer. The list of references is short, but many of the articles are themselves reviews and contain extensive references. The same subdivisions have been used as in the 1950 review.

NEW MATERIALS

The synthetic resins which have appeared in the past four or five years are finding wider applications (1, 2, 3, 4, 5).[1] Generally their military uses appear not to be discussed in current literature, but it is expected these resins will experience accelerated development because of military needs.

PROPERTIES OF PLASTICS: CHEMICAL, THERMAL, AND PERMANENCE

Several articles are listed as typical of the interest in the retention of physical properties under various conditions of use (6, 7, 8, 10, 12). The ever-widening range of application of plastic materials demands more and more information concerning their behavior at temperatures other than room temperature and in the presence of various chemicals (9, 11).

PROPERTIES OF PLASTICS: MECHANICAL

A number of interesting articles concerning the mechanical properties of various plastics are compiled in groupings according to subject matter. The articles of general interest are listed first (13, 14, 15, 16, 17), and then are followed by articles on elastomers (18, 26), thermoplastics (19), thermosetting materials (20), specific materials (21, 22, 23, 24, 25), and miscellaneous items.

An item of general interest to mechanical engineers concerns the general properties of plastics materials (13). Impact tests are discussed in a survey of sources of variation in impact strength results (14). A new summary of chlorotrifluoroethylene plastic properties is of interest for augmenting existing information (27).

TEXTILE FIBERS AND FINISHES

It is recommended that the mechanical engineer should look into the articles listed pertaining to textile fibers inasmuch as several of them are of a general nature and describe some of the new fibers which are becoming more available (29, 30, 31, 32, 33). Other articles have been selected to cover specific topics on processing of synthetic fibers (34, 35, 36, 37).

PAPER LAMINATES AND REINFORCED PLASTICS

Laminated paper plastics continue to be used more and more widely (47, 48, 49, 50). One article discusses decorative laminates as a survey (38), and another describes the use of laminated materials for freight-car bodies (40), and gears (39). Both wood and paper laminates are employed.

The use of polyester resins laminated with glass fibers or reinforced with glass fibers is discussed in a number of articles (41, 42). Methods of fabrication are discussed at considerable length (43, 44, 45, 46), and one survey article is published in three parts (42).

The use of glass fibers with polystyrene as molding compounds has not been described extensively in the literature if at all. This is rather new and very little background of reliable information appears to be available.

PROTECTIVE COATS

Silicone finishes for baked enamels for sheet-metal protection are discussed in an interesting story (53). Paints for domestic use in decorating and protecting are discussed in other articles (51, 52, 54, 55, 56).

COATING AND CALENDERING EQUIPMENT

Two articles describe calendering equipment and auxiliaries (57, 58), and one article describes a coating method for extrusion deposition of polyethylene on paper (61). Another article describes thermoplastic coatings (60).

A double-screw compounding mixer is described in an article which is of interest because the machine has been put to work in production of colored formulations by several thermoplastic-material manufacturers (59).

PLASTIC MOLDS AND MOLDING

Several articles describe new moldmaking ideas (62, 63, 64, 65), and one article describes a method of using fluid heating and cooling for molds and calender rolls (66).

Molding the specialized plastics such as silicone rubbers, trifluorochloroethylene, mineral-filled alkyds, and melamine resins is described in an article written by several experienced men (67).

Slush molding of vinyl plastisols describes the latest technology in this new field which is expanding rapidly because of improvements in the plastisols resins and in the molds and technology of molding (68).

A series of articles on successful designing for plastic molding appeared in a British journal (65), and in the same journal is an article on a special mold for producing interrupted internal threads without stripping or unscrewing (64). Molding and extrusion of Teflon are described (69), and a dimensional tolerance system for molded parts is included (70).

VINYL FILMS AND SHEET

Embossing of vinyl film as it comes from the calender has produced new design-pattern effects. This has been brought about by the use of the Dornbusch system of engraving the embossing rolls (72, 73). Color problems on vinyl films are discussed (74).

Solution-cast film is a subject of an article which tells of the properties of such films (75).

Of interest to packaging people is an article on the permeability of polymeric films to gases (71).

[1] Numbers in parentheses refer to the Bibliography at the end of the paper.

Contributed by The Rubber and Plastics Division and presented at the Annual Meeting, Atlantic City, N. J., November 25–30, 1951, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

INJECTION MOLDING

A motion-picture study of the injection-molding cycle is described in one article, and several conclusions concerning the practical and theoretical considerations are drawn (76).

An excellent description of injection molding of phonograph records is listed (77), and the latest advances in dry coloring are described (80). Both of these subjects are of interest to plastic molders and to engineers charged with the responsibility of economical molding of high-quality articles. Interesting molding operations and machines of large size are described in two other articles (78, 79).

EXTRUSION

The extrusion technology for producing polyethylene monofilaments is discussed in one article (83), and two articles describing extrusion compounding are listed (81, 82). Extrusion blowing of bottles is discussed (117).

PLASTIC MATERIALS, USES

Many articles on the uses of plastic materials have been scanned and considered for inclusion in this review. Only a few of them are mentioned, and these have been selected from the standpoint of general interest as well as certain specific interests which may be aroused because of the significant advances described in the articles.

The use of polystyrene injection-molded patterns for lost-wax casting of nonmachinable metals has been growing during the past year (87, 113). Fabrication of the fluorocarbons has advanced considerably (109). Plastics have been used extensively as ion-exchange resins (106, 107). Molded gears of nylon have become widely used in applications in which the gears have done very well (100, 101, 39).

Phenolic resins have been used to strengthen foundry sand for dry-sand molds (114). Phenolic resins have been used also to reclaim sawdust which is an age-old problem (115). Foams of various materials are becoming more important. One article reviews five different types of foams (98, 99). Application trends and engineering progress during 1950 are outlined in several articles which are of considerable interest (84, 85, 86, 87, 88, 95, 102).

A low-temperature formulation of polyvinyl chloride is described for temperatures of —100 F (104). The use of plastics in radioactive measurements is described (107). Several applications cover plastic gaskets (89, 94, 108, 110).

Uses of elastomers are described (90, 91, 92, 93), and miscellaneous applications of possible interest are listed (96, 97, 103, 111, 112, 116, 117).

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DEFENSE WITHOUT INFLATION—*or* INFLATION WITHOUT DEFENSE?[1]

By ROMNEY ROBINSON

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

SCIENTIFIC discoveries—or those who exploit them, if you prefer—have terribly multiplied the ravages of warfare. But science has done more than that. It has increased manyfold the cost of making military implements. These tools have grown so intricate that to produce them in the volume and variety needed for defense taxes even the strength of so productive a nation as the United States. The economic problems of national defense are serious. They are the subject of four volumes which the Twentieth Century Fund, through its Committee on Economic Stabilization, is now producing. The first of these is "Defense Without Inflation,"[2] by Dr. Albert G. Hart.

A READINESS ECONOMY

"Defense Without Inflation" is a book about what Hart calls a "readiness economy." It is not so much concerned with the military and industrial organization demanded by the outbreak of full-scale war as it is with that needed for "negotiating from strength." This policy requires the nation to be ready to mobilize full scale, should that be necessary, but since its primary objective is to prevent war if possible, it lacks the sharply focused objective of all-out mobilization. Instead, it must have considerable flexibility, and its planners can never quite answer the question: How long will this last? For the answer rests largely in the Kremlin, whose occupants have not seemed too open-handed in supplying useful information. A readiness economy requires a sharply increased flow of tanks, guns, and airplanes, provision for a continuing flow of fuel, repair parts, ammunition and the like, to service them, and above all, an industrial plant capable of rapidly expanding the output of these goods on short notice. The public must furnish the manpower and submit to economic sacrifice without ever being given precise, carefully wrapped explanations of why they must do so. The longer a readiness economy succeeds in its objective, the greater the danger that people will seek to throw off the burdens it imposes. Now the stock Marxian argument used to be that capitalism would collapse as the result of recurring unemployment and depression; but it may be that Marxist thinking has been quietly revised, and is now reckoning on capitalist collapse through the dangers of over-full employment.

Chief among these dangers is inflation. It concerns Dr. Hart, as his title would suggest. Chapter 4 analyzes the inflationary bias resulting from mobilization, and the succeeding chapters on direct controls, budget policy, and monetary policy are in the main discussions of anti-inflationary prescriptions. Now any effective anti-inflation dose is a bitter one to swallow. If people are to be persuaded to down it, they must understand why it is needed and what will happen if they do not.

Any nation operating in the vicinity of full employment, accustomed to reasonably high material living standards, which must turn a goodly chunk of its resources into defense production, is in considerable danger of an inflationary spiral. Since men and materials must be turned to war production and since there is no great slack in the form of idle men and factories, some cut in the output of civilian goods must follow. In its simplest form, the inflationary problem is this: Somebody must submit to a cut in living standards—but who? The spiral of prices is the result of a struggle in which each group in the society tries to push the sacrifice off onto someone else.

WHERE INFLATIONARY PUSH BEGINS

In monetary terms, the inflationary push begins when men and machines are put to war production. Their money earnings are as great or greater than before, yet their contribution to the flow of finished civilian goods has ended. Money earnings—the major source of money demand for goods—are no smaller, but the supply of purchasable goods has shrunk. Given this demand excess, the sellers of goods must either hike the money value of their goods, via a price rise, into equality with money demand or else turn customers away empty-handed. Feelings of social responsibility may restrain a seller from dropping new and higher price tags into his display windows, but these sentiments must battle ever-mounting pressure to change prices.

For one thing, patriotism conflicts with tradition; in peacetime it is expected that one should thrust prices upward until excess buyers have been squeezed out and only sufficient remain to carry away the available supply. But there are stronger forces at work. At the onset of rising money demand, some suppliers will inevitably take advantage of a chance to boost their money income by boosting prices. Once begun, any seller who fails to follow suit must fall behind in the standard-of-living race—or some of those who look to him as a source of income must do so. The single proprietor finds his income cut first by rising raw-material costs and second by rising prices of the things he and his family buy. At the corporate level, union pressure for higher wages is intensified as the rising cost of living crowds workers. (Unions are likely to demand also that the wage rise shall not be followed by a price rise, which in effect is a demand that the sacrifice be borne by the corporation's shareholders.) The employer who resists wage demands is in danger of losing his labor force, notably to the defense industries. In the resulting conflict of pressures, the weakest element yields—prices.

SPIRAL OF RISING PRICES

This is only the beginning of the spiral. Rising prices feed upon themselves as business firms and consumers scramble to stockpile goods before their cost rises still higher. But this speculative buying could not be sustained were it not for the

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[1] One of a series of reviews of current economic literature affecting engineering, prepared by members of the Department of Economics and Social Science, Massachusetts Institute of Technology, at the request of the Management Division of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Opinions expressed are those of the reviewer.

[2] Published by the Twentieth Century Fund, New York, N. Y., 1951, 186 pages, $2. Dr. Hart is Professor of Economics at Columbia University.

more important fact that money earnings have been boosted by higher prices, and higher earnings swell the flood of money demand to reproduce the original inequality of supply and demand. In normal times these spirals peter out, for not every dollar of new earnings means a dollar of new spending; some dollars are drawn off by taxation and by saving. This is especially true when the economy is well below full employment, for production can then be expanded without resort to the higher earnings resulting from overtime pay, and the response of increasing supply is adequate to meet the rise of demand. It is not the case when civilian supplies have shrunk, instead of increasing. Higher money earnings then become an illusion for the average man; instead of fulfilling the promise of a higher real income, earnings lag persistently behind consumer prices. Not every man is average, of course. Small minorities with sufficiently good strategic or bargaining-power positions inevitably keep level with the push of consumer prices or even edge ahead of them; and their example intensifies the impossible struggle of the less-fortunate majority to reach the same goal. In this struggle to keep up, the "leakage" of savings away from the spending stream—the brake that normally restrains the spiral—dwindles. In the economist's jargon, the "marginal propensity to spend out of income," instead of having only a fractional value, approaches one in magnitude.

The jerky, accelerating rise in prices of an unchecked inflation is the symptom of an underlying conflict between groups in the economy as they frantically elbow one another to escape bearing a burden that must be borne by someone. The material loss falls most heavily upon fixed-income recipients and others whose elbowing power is weak. But the social loss must be tallied in terms of the bitterness engendered between groups, the frustration resulting from a conflict the participants cannot understand, and the loss of confidence in the key mechanism of a free-enterprise economy—the price system.

This intergroup struggle, in more restrained form, goes on in peace as well as war, but it is conducted without tearing the social fabric apart. The persistent excess of money demand means, in effect, that the Queensberry rules have been thrown away. No anti-inflationary program can possibly succeed unless it is founded on an understanding by the public that the burden of reduced living standards must be carried and that government action will spread it as fairly as possible.

WHAT CAN BE DONE ABOUT INFLATION?

In the main, the foregoing description tallies with that of "Defense Without Inflation." But Dr. Hart does not emphasize intergroup conflict as the driving force behind inflation (and indeed might even disagree with this interpretation). Rather, he treats it as one of the unhappy consequences of inflation. The spiral is analyzed as the consequence of interaction between a "demand pull" and a "cost push" on prices. This can be misleading to the unwary reader in so far as it suggests that the two are independent forces. The significant fact about inflation is that they are *not* independent, for rising costs mean rising income to someone else, and rising income means rising demand. But this is a quibble. Far more important are the questions: How much inflation are we in danger of during the next three or four years, and what can be done about it?

The President's Economic Report of January, 1952, supplies some later figures than were available to Dr. Hart. The consumer-price index rose only moderately during 1951, and the wholesale price index may even have registered a slight decline. Federal government expenditure for goods and services totaled about $42 billion, of which about $38 billion went for national security. The latter figure was somewhat less than had been estimated by Hart (writing early in 1951) and others, and the government actually ran a cash surplus of about $1 billion. Security expenditure, even though it rose by some $17½ billion, did not bite very deeply into consumer standards; the public was thus persuaded to save $18½ billion out of its disposable income. It is notable that this figure of 8.3 per cent was the highest registered for any year since the end of World War II. Less comforting is the fact that despite its small overall cash surplus, the government ran a deficit of $5 billion during the last half of the year (the corresponding figure for 1950 was a surplus). The tempo of defense spending is being stepped up. The President's Report estimates an increase of around $20 billion in 1952. Inflation cannot be predicted in terms of any precise amount of money expenditure. But this increase is big enough to warrant concern—unless something is done about it.

The sovereign cure for inflation, of course, is increased production. But as Hart points out, its worth may be overestimated. Increased production checks inflation; but because it means also an increase in earned incomes, extra production of $25 or $30 billion would be needed to match an "inflationary gap" of only $10 billion. The needed increase in civilian production cannot be obtained, and there is nothing for it but to cut money demand down to size.

The stock suggestion at this junction is that government's demand should be trimmed. But its advocates will find little comfort in "Defense Without Inflation." Hart is undoubtedly as strong for economy and efficiency in government as the next man, but the previously cited 1951 budget figures illustrate the difficulties of this "easy" remedy. Out of $42 billion in federal expenditure for goods and services, some $38 billion went for national security. Government's "transfer payments"—pensions, veteran payments, and the like—are not included in these figures, but the point seems clear enough that anyone who seeks a remedy by trimming government spending must do most of his whittling inside the security program.

Unless we obtain a tremendous (and unlikely) increase in what the military dollar will buy, the cut must come in the private sector. If the public can be persuaded to curtail spending voluntarily, so much the better. But it is not easy to interest people in saving more today. People who bought savings bonds in 1942 for $75 and redeemed them in 1950 for $90 have not forgotten that they received not much more than $60 in 1942 dollars. Bonds redeemable in dollars of constant purchasing power would be far more attractive. They might, in fact, be so attractive as to have catastrophic effects on the price of other gilt-edged securities. They would have to be issued on some form of individual quota basis; and as Hart points out, they would not serve their essential purpose unless bought with the pledge to cut down on current spending—a difficult pledge to enforce. Otherwise, the public would simply dump other assets in order to buy them.

ROLE OF TAXATION

To the extent that people will not voluntarily withdraw sufficient money from the spending stream, it must come from them involuntarily—by taxation. Like most economists, Hart places considerable emphasis upon the personal income tax. His suggestions include a tightening-up of taxes collected from farmers, self-employed business and professional men, and landlords, withholding taxes on dividends and bond interest, and removal of the present discrimination in favor of home owners. Suggestions for stiffening personal taxes are something less than politically popular. But as noted earlier, effective anti-inflationary medicine is always bitter, and it can be made palatable only if people feel that the doses are

being distributed as equitably as possible. In line with this reasoning, increases in corporate taxes seem inevitable. Criticisms of these taxes are considerable, but wage earners are unlikely to accept wage-freezes and heavy personal taxes if they feel, with whatever justification, that stockholders are dodging their share of the load via undistributed and lightly taxed profits.

The effects of a stiff budget policy can be canceled out if, as fast as taxation siphons money out of the spending stream, expanding bank credit creates new money to replace it. Budgetary policy must be backed by monetary policy to restrict margin buying of stocks, installment credit, charge accounts, and real estate credit, in addition to its traditional job of controlling bank credit. The other "traditional" responsibility of the monetary authority is regulation of government bond prices. The Treasury has argued that its long-term securities, with a coupon rate of around $2^1/_2$ per cent, should be kept priced at par or better, for any sag below par boosts the effective interest rate on such bonds and forces the Treasury to offer a correspondingly higher interest rate on any renewal issue it wishes to sell. The trouble with this policy is that it requires the Federal Reserve System to buy bonds in whatever quantity is needed to keep their price at par. Bonds cannot be used directly for spending purposes, but when the Federal Reserve has undertaken to exchange them at any time for money equal to their maturity value, every bond represents a potential addition to the money stream, and an addition likely to be made just when additions are particularly undesirable. The effect can be especially unfortunate when the bond seller is a bank, for the fractional cash reserve requirement permits the banking system to expand every dollar of extra cash into four or five dollars of extra bank credit. Hart, writing just about the time when the Federal Reserve broke with the Treasury and permitted bond prices to sag, is critical of the Treasury's viewpoint. Subsequent events have validated his criticism, for bank credit has grown tighter and loans harder to obtain.

DIRECT CONTROLS

There remain direct controls. Nearly all economists would agree that a policy of direct controls, notably wage and price controls, will not work unless backed by adequate fiscal and monetary policies. Many would argue that given these policies, wage and price controls are unnecessary, save in time of actual war. The need for direct controls is argued whenever a society has to meet certain vital requirements without too much delay. Priorities and supply allocations seem obvious methods for channeling scarce materials to those industries where they are most needed. The alternative would be to supply defense industries with sufficient cash to outbid nonessential users. This price bidding is the peacetime mechanism by which a free-enterprise economy makes up its mind what goods it is going to produce. But in peacetime there are few no-delay "musts," and government decisions are not the major factor in determining the bill of goods. For the most part, the public, with a few nudges from the advertising agencies to be sure, makes its own selections, and the process does not run off into inflation because private spenders have not the power to create new money. The only trouble with using seemingly more efficient direct controls in a critical situation is that the more they are used, the more the peacetime mechanism may atrophy. Price and wage controls, more explicitly anti-inflation controls, override this mechanism in more obvious fashion. They may help; price control may restrain speculative buying, and wage control the agitation for higher wages. But it is understandable that anyone interested in the long-run survival of a free economy would be concerned regarding them. This concern is evident in the final chapter of "Defense Without Inflation," written by the Twentieth Century Fund's Economic Stabilization Committee.[3] As it points out, any discussion over the shortcomings of direct controls has been rendered somewhat academic by the government's decision to use them. But it is interesting to speculate how this chapter would have varied had it been written before the government's decision. As Hart remarks, "our traditional long-term economic objectives of freedom, opportunity, and progress are part of what the struggle is about."

"Defense Without Inflation" is an excellent discussion of the heavy strains thrust on democratic society by a readiness program of uncertain duration. Too many direct controls may warp its structure, and inflation can tear it apart. To agree simply that "there is danger ahead" is not enough. There must be a broad measure of agreement on the nature of the danger and what to do about it. In practice, this calls for bipartisan agreement and a considerable measure of confidence in the governing authority, for the situation will not stand too much political infighting. Otherwise, anti-inflationary checks are likely to prove completely unworkable. Hart has made a noteworthy contribution to public understanding of these problems. It is a readable book, written by a first-rate economist.

Changing Philosophies on Wage Incentives

(*Continued from page 279*)

asked its advisers to suggest a wage-incentive plan which as nearly as possible would meet the desires of the workers and still be a practical plan from management's viewpoint. Presently a plan called the Equitable Bonus plan was developed. This plan pays the same bonus to all workers who meet or better standards, but checks performance on an individual or small-group basis. Management accepts the responsibility of developing methods, providing accurate standards, and seeing that the operators are instructed properly. The union accepts the responsibility for maintaining a proper working pace. The plan has the feature of equality of earnings for all who do a reasonable day's work which is in line with the current beliefs of the workers as to what is right. It checks the performance of the workers on an individual or small-group basis, so that the substandard workers are identified. Since they do not earn bonus, an incentive is provided to improve, which is desirable and right from management's viewpoint. Both management and the union have accepted this plan enthusiastically, and although the installation is still too new to be able to report results, both sides have agreed to the plan with the firm intention of making it work.

THE IDEAL APPROACH

This, in my opinion, is the ideal spirit in which wage incentives should be approached. The plan should be backed up by sound methods and standards work. It should be set up with enough time allowed to do a proper job. But the plan itself should be tailored to the group it is to serve. It should be developed on the basis of a thorough understanding of the philosophies past and present which underlie wage incentives. And it should be developed with an understanding of the current basic attitudes of the group itself. If this is done, wage incentives can truly achieve the potential benefits which they offer in an atmosphere of harmonious human relations.

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[3] Composed of four well-known economists: John M. Clark, Theodore W. Schultz, Arthur Smithies, and Donald H. Wallace.

BRIEFING THE RECORD

Abstracts and Comments Based on Current Periodicals and Events

J. J. Jaklitsch, Jr., *Technical Editor*

MATERIAL for these pages is assembled from numerous sources and aims to cover a broad range of subject matter. While few quotation marks are used, passages that are directly quoted are obvious from the context, and credit to original sources is given.

Federal Standardization

CO-OPERATIVE arrangements to improve standards, specifications, packaging and packing requirements, and inspection policies in executive agencies of the government were announced recently by the General Services Administration, the Department of Defense, and the Bureau of the Budget.

An "area of understanding" agreement provides that military and civilian procurement operations will be closely co-ordinated with respect to the technical functions of developing standard purchase specifications and their use, packaging standards, inspection policies, and others.

Under the agreement, the Munitions Board Standards Agency is designated to represent the military and GSA's Federal Supply Service will represent all civilian agencies.

Major specific points of the agreement include the following:

1 Co-operative development of Federal Specifications covering common items of supply in Government and their mandatory use by all agencies, military and civilian, wherever practicable, after a one-year trial period, during which they would be known as Interim Specifications and optional for use.

2 The co-ordinated development through the Munitions Board's Standards Agency of military specifications covering items required for national defense which would be mandatory for use by all military agencies after a trial period during which they would be known as Interim Military Specifications and optional for use.

3 Elimination of duplicate or nearly identical specifications so that a single document can be used.

4 Greater utilization of nationally recognized industry and technical-society standards and specifications "to the maximum extent" with corresponding reduction in the development of specifications for items where the volume of procurement is not sufficient to warrant the expense and effort of preparing a specification.

5 Co-ordination in the problem of developing uniform standard quantity packs for items frequently handled, and of providing standard packaging requirements to meet the varying needs for both domestic and export shipments.

6 Maximum utilization of existing inspection and test facilities and agreements to develop inspection policies and procedures mutually, including inspection manuals and training methods.

The agreement, in effect, narrows the gap between what is purely a military item and a civilian item, and brings the resources of all parties to bear upon the problem of handling singly the work connected with supplying those needs which all agencies use. The agreement also initiates for the first time a concerted effort between the military and civilian agencies to standardize the items which are used in common by the Federal Government.

A supplemental agreement has also been signed between the Department of Defense and GSA defining specific tasks and outlining methods under which the co-operative program is to work.

The agreement is the fifth thus far concluded by directive of the President, between the Department of Defense and GSA, since the creation of GSA on July 1, 1949. The others related to traffic management, utilities, communications, and co-ordination of civilian and military procurement in Government. All of these agreements are in line with recommendations made by the Hoover Commission.

Surface-Finish Standards

UNIFORM precision in surface-roughness measurement, accurate to one millionth of an inch, will now be possible for the first time in factories, shops, and engineering laboratories throughout the country, according to a joint announcement by General Motors Research Laboratories and Chrysler Corporation Engineering Division.

The announcement climaxed a seven-year co-operative engineering project, with research and development costs borne by Chrysler and General Motors, to perfect for all industry a set of Precision Reference Specimens of Surface Roughness on pure-gold master blocks.

Significance of these master specimens in the field of surface-

How to Obtain Further Information on "Briefing the Record" Items

MATERIAL for this section is abstracted from: (1) technical magazines; (2) news stories and releases of manufacturers, Government agencies, and other institutions; and (3) ASME technical papers not preprinted for meetings. Abstracts of ASME preprints will be found in the "ASME Technical Digest" section.

For the texts from which the abstracts of the "Briefing the Record" section are prepared, the reader is referred to the original sources: i.e. (1) The technical magazine mentioned in the abstract, which is on file in the Engineering Societies Library, 29 West 39th St., New York 18, N. Y., and other libraries. (2) The manufacturer, Government agency, or other institution referred to in the abstract. (3) The Engineering Societies Library for ASME papers not preprinted for meetings. Only the original manuscripts of these papers are available. Photostat copies may be purchased from the Library at usual rates, 40 cents per page.

finish measurement is said to be comparable to the importance of the well-known Johansson blocks for dimensional measurement standards.

Adoption of uniform standards will have far-reaching importance in synchronizing precision production for national defense as well as civilian manufacture.

For many years General Motors and Chrysler engineers, cooperating with Society of Automotive Engineers and American Standards Association committees, have been working on surface-finish problems, but not until 1945 was a joint project to develop recommended uniform surface-roughness specimens conceived by the two companies and put in operation.

Standards defining the specimens have since been prepared by Sectional Committee B46, under the administrative sponsorship of ASME, and adopted by the American Standards Association. They have been published by ASME and are available to everyone.

The University of Michigan Physics Department contributed to some of the earlier work in this project with use of a ruling machine for tests that indicated such standards were feasible.

Reproduction of the master specimens will make it possible for a machinist in a one-man shop, as well as a foreman in a big factory, to calibrate his measuring device by the same standards as the engineer who worked out the original specifications.

Up to now there have been no established standards for surface finishing. Each company more or less set up its own. This resulted in lack of uniformity in surface finishes. Variations in surface-roughness values often made it difficult, if not impossible, to match parts or components from different shops in precision production.

The F. A. Ringler Company has undertaken to manufacture these blocks. With its predecessor, the United States Rubber Company's electroforming division, the F. A. Ringler Company contributed an electroplating process which made possible accurate replicas of the gold master specimen standards developed by Chrysler and General Motors.

Here is how the replica specimens are used:

Every machined, ground, honed, or lapped surface in production has a roughness value. Microscopically, a surface is marked by minute scratches, grooves, or peaks and valleys. Holding these peaks and valleys within certain standard limits or roughness values is a key problem in industrial precision work.

The new Precision Reference Specimens of Surface Roughness provide constant roughness values. Thus engineers or machinists working with precision parts can compare the roughness value of the part with one of the specimen blocks and determine immediately whether the machined surface has a proper roughness value.

Metal Cutting

A METAL-CUTTING process developed at the Metalloid Corporation, Huntington, Ind., makes use of a new chemical compound known as Metalloid X-20, which acts to limit the movement of the atoms in the crystal lattice of the metal when it is being cut. According to reports, the new process is being applied to many difficult machining operations with marked improvements in cutting-tool life. In some instances of thread chasing and tapping, increases of 900 per cent have been recorded. In practically all cases speeds and feeds have been increased 25 to 35 per cent.

The action of the compound may be likened to the physical changes occurring in steel when it is hardened by nitriding or carburizing, the most significant difference being that of the depth of penetration of the active elements. The effects of

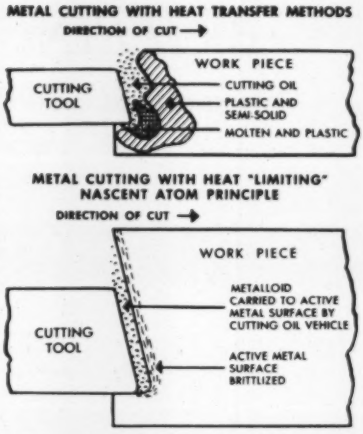

FIG. 1 PRINCIPLE OF NEW METAL-CUTTING PROCESS

Metalloid X-20 are limited to approximately one molecular layer each side the separated area, due to the extremely short time available for penetration.

The new product, it is said, has none of the heat-transfer properties of conventional cutting oils—but will use any cutting oil as the vehicle to carry the nascent atoms to the active metal surfaces to limit heat generated. Reports on a deep-hole boring job using high-speed tools indicate the feed was increased from 0.004 to 0.010 in. The surface feed was increased from 144 to 288 sfm, with tool life increased five times.

The material which serves as the basis for this metal-cutting principle is said to function by reducing and limiting the quantity of heat generated by the plastic flow of the metal during the cutting operation. Consequently, both the tool and work remain much cooler than when machining under ordinary conditions. The reduction of plastic flow in the work also results in greatly improved surface-finish quality, the manufacturer states.

Metalloid X-20 limits the plastic deformation or flow at the point of cut and acts to reduce the temperatures of tool and work well below the critical point where tool hardness is affected. Use of the new material is said also to limit plastic deformation and to eliminate built-up edges on tools caused by attachment of the semimolten metal which solidifies when work is stopped.

The theory behind the development of the compound is that the Btu's generated per cubic inch of metal removed are directly proportional to the degree of plastic deformation and the number of cubic inches of metal per minute being removed. In actual operation the zone of control is at the point of active metal at the cut where the nascent atoms in X-20 are released to penetrate the active metal to create a brittle effect in the metal for the succeeding cut. The added brittleness thus obtained in the work reduces plastic deformation during the cut and reduces heat generation to only a fraction of that formed by conventional methods.

Use of Metalloid X-20 is said to be giving excellent results when used with titanium steels, boron steels, stainless, and other high-alloy materials. It is claimed that production runs on numerous high-priority jobs with high-speed tool steels have shown a performance equal to the best carbide tools.

In other instances the use of Metalloid X-20 has enabled annealed carbon steel, which has soft stringy characteristics,

to be machined with tool economy and efficiency of ordinary free-machining stock—after other methods failed completely.

Metalloid X-20 is said to be practical for control of heat and to provide extension of tool life for any metal-machining operation including turning, broaching, gear cutting, drilling, milling, threading, and tapping. The material is completely soluble in all types of petroleum oils and solvents, and can be easily removed by vapor degreasing, or in emulsion or alkaline cleaning solutions.

Gouging Electrode

A SPECIALLY formulated electrode designed for gouging, chamfering, cleaning, and partial milling operations on any metal or alloy was announced and demonstrated recently by Eutectic Welding Alloys Corporation, Flushing N. Y.

Important new timesavings are claimed by the manufacturer since the new product, "ChamferTrode," it is reported, speeds up fabricating of armor plate and similar difficult to cut alloys. Added features include the use of the electrode as a short cut to faster machining operations since it is said to remove unwanted metal in a flash, thus helping to increase capacity of much-needed machine tools.

The newly developed electrode features a heavy coating which forms a cone at the striking end of the electrode, providing a natural jet-effect arc. Thus an intense concentrated source of heat is created which readily removes unwanted metal of all types so swiftly that the metal itself remains relatively cool.

The surface of the gouged or chamfered material that has been acted upon by the electrode is said to be free from oxidation and slag, thereby providing a clean surface for later brazing or welding operations which may be desired.

The chamfering blast is so concentrated that warping on thin material is negligible and in all cases the physical properties of the base material are claimed to be unaffected.

In addition, the heavy coating is designed so that arc establishment is momentarily delayed, thus enabling the operator to preplace the electrode exactly at the precise point at which he wishes metal to be removed before lowering his shield or protective glasses to proceed with the work.

Regular d-c welding machines are used as the power source. Since these are normally readily available throughout the plant where work of this type is done, great economies in materials handling can be made. The new chamfering electrode requires no auxiliary oxygen, no special gases, no air, or other special equipment.

Ore-to-Iron Furnaces

ELECTRIC furnaces that can turn ore directly into steel are within the realm of possibility, according to H. S. Newhall, sales manager of the smelting division of Pittsburgh Lectromelt Furnace Corporation of Pittsburgh, Pa. Development of this type of furnace would solve the troublesome shortage of steel scrap, since the ore would be the only raw material charged into the furnaces, Mr. Newhall said.

This was predicted with the announcement that Lectromelt has received an order from a South American country for two electric smelting furnaces that turn ore directly into pig iron. This type of furnace has been proved in some 25 installations in Europe, but has never before been used here.

Capacity of the 18,750-kv ore-to-iron furnaces for South America will be 200 tons per day. Design of the furnaces differs from the conventional electric furnace in that six carbon electrodes are arranged in a line, permitting the electrodes to be spaced to meet different ore conditions. This type of furnace layout has been used successfully in smelters for nickel, copper, and titanium ores, it was reported.

Ore-to-iron electric furnaces were developed for use in some parts of Europe because coke is scarce and expensive and electricity costs are relatively cheap. Their record of service cannot be overlooked, and the U. S. steel industry may be passing up a good bet if it does not pursue the development of ore-to-iron furnaces, which would eliminate reliance on the ever-fluctuating supplies of steel scrap, according to Mr. Newhall.

Controlled-Atmosphere Furnace

CARBON-RESTORED bars are being supplied to customers with a new controlled-atmosphere furnace now in operation at the Hazelwood Cold Finishing Department of Jones & Laughlin Steel Corporation, Pittsburgh, Pa. This makes possible the attainment of heat-treated hardness at the surface without the necessity of removing a decarburized skin, it is reported.

The big furnace, of the car-bottom type, has been in use since Dec. 1, 1951. Installed by Surface Combustion Corporation, Toledo, Ohio, it is said to be the first furnace of its kind to be designed specifically for carbon restoration.

The furnace also will perform other thermal treatments—annealing, bright annealing, spheroidizing, and normalizing.

As steel passes through the various shaping processes, from ingot to bar, it is alternately heated and cooled, successively. This tends to deplete the carbon from the skin of the bar, leaving it decarburized.

The fabricator who wants a bar with enough surface hardness to resist wear and abrasion would have to machine or grind such a decarburized bar, prior to heat-treating, to remove the soft unhardenable skin. This is a loss of metal, time, and money.

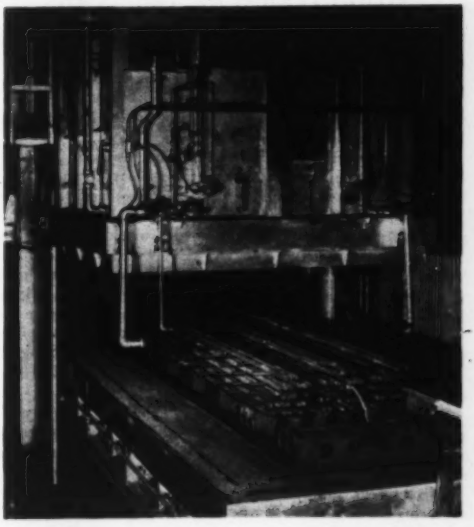

FIG. 2 CAR BOTTOM OF NEW CONTROLLED-ATMOSPHERE FURNACE IS SHOWN, WITH A CHARGE OF BARS, MOVING INTO PLACE BENEATH THE FURNACE COVER WHICH IS IN RAISED POSITION

But, states Jones and Laughlin, with the new process this surface-metal removal is not required, as sufficient carbon is restored to the surface to insure that the desired surface hardness will be obtained in heat-treating.

For orders where carbon restoration is desired, this is accomplished as follows:

The cold-finishing mill receives hot-rolled bars from J&L mills, pickles them, and sends them to the furnace.

The charge of bars is placed on work supports on the car bottom. The furnace can hold up to 80,000 lb of bars, depending on their size.

With push-button control, the car rolls under the furnace cover, and the cover is lowered onto the bottom enveloping the charge. Now the furnace is ready to receive its "dual gas" atmosphere, supplied from gas generators.

The first gas, "NX," is an inert mixture of nitrogen, carbon monoxide, and hydrogen. This inhibits any reaction on the surface of the bars while the furnace is being brought up to working temperature.

When the working temperature is reached, the second gas "RX," is forced into the furnace. It also consists of nitrogen, carbon monoxide, and hydrogen, but it is far richer in carbon monoxide, which provides the necessary high-carbon potential for carbon restoration.

The carbon from the carbon monoxide impregnates the skin of the bars, and migrates inward. This carbon migration, under intense heat, is the process that produces bars free of decarburization.

One of the important characteristics of this method of carbon restoration is that carbon can be restored to the decarburized skin in varied amounts, whereas case-carburizing can produce only a layer of high carbon content.

The carbon-restored bars, which J&L cold-draws to any specified section, then are ready for the fabricators' heat-treating.

Iron-Oxide-Ore Behavior

A SIMPLE timesaving laboratory test that predicts quickly and accurately how iron-oxide ore from a newly opened deposit will react in a pig-iron blast furnace has been perfected by the U. S. Bureau of Mines, Department of the Interior, in the Mines Experiment Building on the University of Minnesota campus in Minneapolis, Minn.

Now proving beneficial to the nation's iron and steel industry, the test has resulted in more efficient blast-furnace operation, increased iron production, and the conservation of scarce coke. It also has saved industry many months of making comparative tests to determine how untried iron-oxide materials will reduce in a furnace.

Known as the loss-in-weight method, the test is conducted in an electrically heated retort, suspended from a sensitive balance or scale used to determine the amount of oxygen removed from an iron-oxide charge. It is considered an improvement over other methods because of the rapid direct weighing, done while the charge is in the retort. The test can be completed within a few hours.

Information obtained from the test enables industry to prepare iron-oxide materials so as to get maximum iron production in the blast furnace. For example, results of a Bureau of Mines test prompted one steel company to crush the ore to finer size, which led to increased iron production.

During the test, ore is crushed to the desired size and heated in the retort, using hydrogen as a reducing gas. The rate at which the oxygen is removed from the ore is disclosed by weighing the charge periodically with the scale. The oxygen combines with hydrogen to give water, which is vaporized.

Shell Molding Process

NEW information on a metal-casting process which was originated in Germany and was fully developed by U. S. Navy metallurgists, is now available to the public, the Office of Technical Services of the U. S. Department of Commerce announced recently.

The shell molding process uses a thin-walled (shell) mold produced by mixing dry sand and a plastic bonding agent. When this mixture is placed in contact with a heated pattern, it forms a shell mold around the pattern. The resulting molds, when filled with molten metal, form a casting. This bonded shell molding process is said to produce castings which are more accurate and have better finish than those produced by the earlier sand mold process. Also, this process is faster, cheaper, requires fewer hours, and less use of skilled labor.

A pamphlet in the Navy's series of Industrial Notes on shop techniques presents full particulars for utilizing this process according to a procedure developed by the Navy. PB 105 131, "Plastic Bonded Shell Molding Simplified," 6 pages, including photographs, sells for 25 cents a copy. Orders should be addressed to the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C., accompanied by check or money order payable to the Treasurer of the United States.

Stainless-Steel Nacelle

AN airplane nacelle made entirely of stainless steel is being produced by Solar Aircraft Company, San Diego, Calif., for the Lockheed P2V-5 Navy patrol plane. The nacelle is being built as part of a large order placed with Solar by Lockheed.

In the past, engine nacelles have usually been made of aluminum. Stainless steel has been employed on this new Lockheed design to obtain greater structural strength with less weight. Under the contract a substantial number of nacelles will be produced. Solar's first nacelles have already been delivered to Lockheed.

Making nacelles of stainless steel was a difficult engineering and production problem, according to the company. To gain maximum strength an extremely hard form of stainless was used, leading to an unusual number of problems in forming the metal to precise specifications. The nacelle assemblies contain

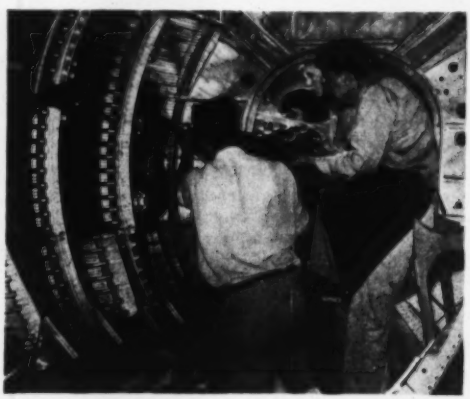

FIG. 3 AIRCRAFT-ENGINE NACELLE BUILT ENTIRELY OF STAINLESS STEEL

470 detail parts, which require the use of a great many special tools, jigs, and facilities.

Each nacelle weighs 175 lb, and on the finished P2V-5, will support an engine weighing 3500 lb. The nacelles are 6 ft high, 5 ft wide, and 6 ft long.

Jet Compressor Blades

A NEW method of producing compressor blades, through fabrication which will relieve a bottleneck in the nation's aircraft turbojet-engine production program, has been announced by the General Electric Company, Schenectady, N. Y.

Developed by the company's Thomson Laboratory, Lynn, Mass., for the G-E Aircraft Gas Turbine Division, the process involves fabrication of the stationary or stator blades of jet compressors in place of the relatively slow and expensive forging technique currently used.

It is reported that the process not only will speed up production but promises great savings in critical materials and millions of dollars annually in jet-engine costs to the armed forces. Also, pressure will be relieved on the nation's forging facilities.

It is estimated that cost reductions of 55 per cent in stator-blade manufacture will be possible through fabrication, and a 39 per cent savings in critical materials could be achieved through virtually chipless production which reduces waste.

G-E is making available the fabrication process, through the U. S. Air Force, to other turbojet manufacturers in the nation.

The Air Force has approved substitution of fabricated blades for forged blades in the General Electric J-47-GE-23 turbojet which is going into large-scale production for the jet-powered medium bomber, the Boeing B-47 Stratojet. Additional production facilities, earmarked for blade fabrication, are planned for the company's Lockland, Ohio, turbojet center.

Fabrication is one of several methods of blade manufacture under investigation by the company as a substitute for forging.

Current J-47 production models, for instance, have approximately 2000 compressor blades, more than half of which are on the stator. The fabrication process has been approved for the stationary blades, while the rotary blades will continue for the present to be forged because of the high centrifugal stresses involved.

Under the precision-forging process, the blade and its base are hammered from a single piece of stainless steel. The airfoil is formed during the hammering process. The base is dovetailed so as to fit into a "blade ring" and the rings holding the more than 1000 stationary blades are pushed into slots in the compressor casing.

Anticipating that the forging process would constitute a bottleneck to mass production, investigations turned to a principle used for some time in steam-turbine manufacture whereby the blades are rolled in long strips, contoured to the proper airfoil, and then simply cut to the desired length during assembly.

The engineers found the process adaptable to turbojet manufacture. The base for the blade, which is an integral part of the forged blade, was a big problem. They spent two years in solving that before hitting upon a way of making a separate base having an opening therein so that the blade could be inserted and welded to it. The base is so shaped that it fills the same area as the present blade ring, thereby eliminating the ring and an expensive manufacturing and assembly process.

The design of the base is such that it provides even greater resistance against vibration that may occur due to occasionally uneven air flows through the compressor. The new blade is much more strongly fastened to the casing, which will minimize the damage caused by a foreign object entering the compressor. Both of these items contribute to longer and safer engine life.

FIG. 4 COMPLETE FABRICATED JET-ENGINE BLADE IS SHOWN AT LEFT, WHILE ON THE RIGHT IS THE FORGED BLADE CURRENTLY USED IN PRODUCTION MODELS OF THE GENERAL ELECTRIC J-47 ENGINE

Limited production of blades for engine testing was begun late in 1950.

Performance tests were run on two engines equipped with fabricated stator blades before any substitution was authorized. After 500-hour endurance tests, thorough examination showed no undesirable conditions or signs of future failure, according to engineers. Performance tests showed no change in efficiency compared to engines with forged blades and one test showed a slight increase in efficiency, although the engineers said this probably was not significant.

Isotopic Steel Inspection

AN ampoule of radioactive cobalt wire is being successfully used by Empire Steel Castings, Inc., of Reading, Pa., for the examination of steel castings for internal defects. The company makes stainless and alloy-steel castings for the manufacturers of pumps and valves and for the food, chemical, textile, and other industries requiring noncorrosive castings.

Irradiated in a nuclear reactor at Oak Ridge, the cobalt isotope sends out powerful beta and gamma rays. The gamma rays are capable of penetrating through steel ranging in thickness from $^1/_2$ to 6 in. When used with a photographic film, the rays will produce a picture of any defects in the steel.

Advantages cited for the isotope are its relatively low cost and its ability to be used without expensive machines. It consists simply of radioactive cobalt wire, mounted in a circular holder, and elevated over the casting by means of a cross-arm attached to a laboratory stand. The height of the ampoule from the steel is determined by the thickness of the steel. Exposures range from $^1/_2$ to 5 or 6 hr.

The isotope is said to speed the work of inspection and it

FIG. 5 RADIOACTIVE COBALT WIRE IS HELD OVER A CASTING BEING INSPECTED

also has a distinct cost advantage over radium. It was purchased for $450. A comparable amount of radium weighing 525 milligrams, would cost approximately $10,000. The unit has a half life of $5^3/_{10}$ yr, but can be used up to 10 yr, with diminished efficiency after the half-life period.

The isotope was purchased from a civilian chemical firm with the permission of the Atomic Energy Commission. No security regulations attach to it, since it is being commercially prepared and distributed.

Steel Production

THE greatest annual production of steel in history, exceeding 105 million tons in 1951, has been achieved by the steel industry, according to *Steel Facts*, February, 1952. This is an increase of more than 4.3 million tons in annual steel capacity during 1951. The capacity is now rated at almost 108.6 million tons, a record high level.

In maintaining world leadership in production, the world's greatest steel industry was more than keeping pace with this fast-growing country.

The greatest production of steel in history last year, totaling 105,134,553 tons of ingots and steel for castings, exceeded the output of 1950 by 8.3 million tons. It was 17.3 million tons over the average annual production of World War II.

Never before had this country had so much steel to use, and most of it went into uses normally regarded as part of the civilian economy. It was the first year in which the total output exceeded 100 million tons.

About 1365 lb of steel were made last year for each person in the continental United States, compared with 1275 lb in the preceding year and about 1000 lb in 1940.

At the same time, in 1951, the steel companies were engaged in their greatest programs of expansion and improvement. Their total annual capacity, now 108,587,670 tons, is rising toward an expected 120 million tons in the United States sometime in 1953. The capacity is now only 9.5 per cent below that figure. A considerably larger increase is scheduled to be made this year.

The expansion cost exceeded $1 billion last year.

In five years the capacity has risen more than 17.3 million tons. That amount of increase, the largest ever accomplished in a short-term period anywhere in the world, almost equals the total annual capacity of Great Britain and is about half of the estimated total capacity of Russia.

The 4.3 million ton rise in the capacity during 1951 could provide finished steel for all the following items: one million passenger autos; 800,000 household refrigerators; 800,000 domestic cooking stoves; 10,000 freight cars; one million television sets; one aircraft carrier; two heavy cruisers; 500,000 3-in. shells; 500 Army tanks; 10,000 airplanes; 3000 six-room houses; leaving about 65,000 tons of finished steel for other uses.

The amount of capacity for each person in the continental United States is now about 1400 lb.

In a single year now, producing at full capacity, the steelmaking furnaces can turn out as much steel as was made in this country from Colonial days to about 1900.

To support the rise in steelmaking capacity, other producing facilities in the industry have been expanded and improved. Blast-furnace capacity went up 1,310,560 tons during the past year and as of Jan. 1, 1952, was rated at 73,782,340 tons annually. Coke-oven capacity was increased nearly 800,000 tons and was rated at 67,060,240 tons a year. Finishing-mill facilities and other equipment were expanded and improved. Much work was done to increase the raw-materials supply.

Blast-furnace capacity is expected to rise to at least 81 million tons by the start of 1954. Last year the furnaces made 71.2 million tons of pig iron and ferroalloys, a record, equal to 98.3 per cent of capacity. Technological improvements are enabling the furnaces to operate more efficiently. The new steel-capacity figure is an increase of nearly 27 million tons, or 33 per cent, since 1940.

At the end of last year the steelmaking furnaces in this country had produced more than one billion tons of steel in 12 years. About 40 per cent of all the steel ever made in this country was poured during those 12 years from 1940 to 1951 inclusive.

To accomplish the prodigious feat of 1951, steelmaking furnaces produced an average of 200 tons of steel every minute, night and day, all the year. They operated at an average slightly over 100 per cent of the January 1 rated capacity, a record.

Titanium Alloys

ALLOYS of titanium and vanadium are being studied for extremely high-temperature application in jet aircraft and guided missiles, according to a paper delivered at the American Society for Metals midwinter meeting in Pittsburgh, Pa., by H. K. Adenstedt, J. R. Pequignot, and J. M. Raymer, of Wright-Patterson Air Force Base, Dayton, Ohio. They said their investigations represent a single phase of an extensive research program sponsored by the United States Air Force at Wright-Patterson's Air Development Center's Materials Laboratory.

Indicating high heat resistance obtainable by alloying vanadium with titanium, the paper said the melting point of high-purity vanadium has been raised through experimentation from the previously established 3137 to 3450 F, an important differential in aerial warfare. Titanium's melting point already had been found to be about 3300 F.

For microscopic observations, the paper said small rectangular samples of the alloy were cut from normally cast ingots, and severely cold-worked by compressing 65 to 75 per cent between hardened-steel blocks. The metallic sections then were homogenized in a vacuum furnace at 1700 to 1800 F for 15 to 20 hr. After the drastic homogenizing, the specimens again were cold-worked and sealed in vacuum quartz tubes.

To establish equilibrium or molecular stabilization, the tubes and pieces were kept from 300 to 600 hr at temperatures varying from 1200 to 1600 F, after which the quartz tubes were broken.

The authors believed that for temperatures of 1345 F or higher, equilibrium actually was obtained. At least for 1200 F, equilibrium very nearly was approached, they said.

Surfaces for microscopic inspection were prepared by wet-grinding through 600-grit silicon-carbide paper, followed by electrolytic polishing.

According to the authors, dilatometry experiments thus far have been conducted to determine expansion of titanium-vanadium alloys between room temperature and 1200 F.

Scrap Needed

MORE scrap means more production for defense, expansion, and better living. To emphasize this, the Chamber of Commerce of the United States is calling on business for a greatly increased flow of scrap to meet the needs of defense and civilian production.

Pointing to recent steel-furnace shutdowns that at the time were widely attributed to lack of iron and steel scrap, the Chamber of Commerce said the need for other kinds of scrap is even greater. Here are the figures:

Iron and steel: The 1952 requirement is for 38 to 40 million tons, that is, from 2 to 4 million tons over the current annual consumption rate and about 10 million tons over the 1950 supply.

Copper: The current shortage is greatly restricting production. The scrap supply is about 50,000 tons short of needs.

Aluminum: Scrap normally provides a third of the aluminum supply. Today there is only half enough to maintain that ratio. In each quarter of 1952 a total of 100,000 lb must be found if requirements are to be met.

Other metals: Scrap shortages of brass, bronze, lead, zinc, and some other metals are just as acute.

The Chamber of Commerce is also releasing a leaflet designed for mass industrial distribution through its member organizations. It outlines steps for business establishments to take to make sure they are retaining no abandoned machines or supplies that could be turned in for scrap. The program does not call for a household campaign, with a gathering up of pots and pans. It is directed at business and industrial sources.

The Chamber is encouraging as a part of the scrap program the setting up of community scrap-mobilization committees through its member chambers of commerce. Nearly 1500 such committees are already at work pushing scrap collections from local business establishments.

The National Chamber suggests that these committees organize their communities for scrap drives to include:

1 Emergency inspection by business establishments to identify all obsolete equipment and unneeded metals, such as iron, steel, copper, brass, bronze, aluminum, lead, and zinc.

2 Prompt sale to dealers of all such surplus.

3 Organization of company cleanup committees, headed by officials with authority to scrap obsolete machinery; making salvage a top-management job organized on a continuing basis.

4 Getting scrap dealers to aid in working out practical programs.

Electric Gluing Unit

PLYWOOD wall panels can now be actually "spot-welded" in place with a portable high-frequency electric gluing unit, perfected by United States Plywood Corporation, New York, N. Y.

The new gluing unit, endorsed by the plywood company after several years of study by its engineers, architects, and chemists, is regarded as an important development because "it permits the use of $^1/_4$-in. plywood paneling to achieve a result which compares favorably with that previously possible only with more costly $^3/_4$-in. material.

The new spot-weld method, it is said, completely eliminates use of exposed surface nails and while it formerly required four to six hours for glued panels to set, the new machine causes the glue to set almost instantaneously.

The completed installation, company technicians found, assures perfectly flush joints and cannot be distinguished from the finest custom job, yet the costs are significantly lower.

Employing the conventional system of erecting plywood paneling, nails or brads are used to hold the panels in place while the glue sets. Using the high-frequency electric gluing

FIG. 6 WORKMAN IS SHOWN ACTUALLY SPOT-WELDING PLYWOOD WALL PANELING IN PLACE WITH PORTABLE HIGH-FREQUENCY ELECTRIC GLUING UNIT

unit, the spot welds take the place of nails while glue in intervening areas sets naturally. The company recommends that welds be applied wherever a nail or brad would customarily be used.

An alternative method would be to nail plywood sheathing to the studs and spot-weld the $^1/_4$-in. hardwood plywood to the sheathing. In this method the entire back of the hardwood plywood is coated with glue and the high-frequency unit is used to apply the welds. Here again, a weld is applied wherever a nail or brad would be required. Conventional plastic resin glues are used.

The electrical units, it is claimed, are safe and simple to use and require only the normal 110-volt current.

Tropical Hardwood

A TROPICAL hardwood, said to be almost five times stronger than White Oak, the most commonly used North American hardwood, has been uncovered during a five-year tropical wood-testing program at the Yale School of Forestry.

The wood, hitherto untested scientifically and virtually unknown outside its native habitat, comes from a medium-sized tree known as Kaneelhart.

Tests at Yale showed it to be one of the strongest and heaviest woods in the world, according to Frederick F. Wangaard, Mem. ASME, associate professor of Forest Products. In addition to being five times stronger than White Oak it is reported to be nearly half as strong as aluminum, although it weighs only a third as much as the metal.

The unusual properties of the wood were discovered during extensive tests undertaken by the Yale Forestry School and sponsored by the Office of Naval Research.

The project already has tested 75 tropical hardwoods and is designed to seek replacements for woods such as teak, oak, and other timbers now standard for various types of naval use.

The Kaneelhart tree carries the scientific name of *Licaria cayennensis*, Licaria being its genus and the latter name coming from Cayenne, capital of French Guiana, South America, where the tree first was classified.

It is found in about 40 varieties in Central America and along the northern coast of South America. A member of the laurel family, it is a distant relative of the sassafras tree found in the eastern United States.

The wood is said to have such high wear resistance that it would make a hard-as-iron and practically indestructible threshold for doorways. It can be machined to a mirrorlike finish.

Professor Wangaard sees many other possible uses, particularly in the industrial field where Kaneelhart would be "marvelous for tool and utensil handles, in textile mill machinery, and for turned-wood products of all kinds."

Although Kaneelhart cannot be grown in temperate climates, it is not a rare tree.

Immediate large-scale commercial acceptance of any tropical hardwood is not anticipated on the basis of our tests, Professor Wangaard states, but data on Kaneelhart and other such woods should serve to arouse the interest of potential producers and consumers.

Using the White Oak (with a norm of 100) as a yardstick in the various tests so far, Kaneelhart was found to have a crushing strength of 467; a bending strength of 311, more than three times that of White Oak; and a density of 168, two thirds greater than White Oak.

Pressures up to 60,000 lb in the School of Forestry laboratory have crushed, bent, and ripped the various tropical hardwoods, while delicate instruments have recorded breaking points.

The usual method of finding the crushing and bending strength of the woods is to insert a 2 × 2-in. block of wood into a giant electrically driven press. In the case of Kaneelhart, the machine could not handle a 2 × 2-in. block, so tests had to be made on a piece measuring $1^1/_2 \times 1^1/_2$ in.

Professor Wangaard said a board foot of Kaneelhart—a foot square by one inch thick—weighs almost six pounds, whereas a board foot of White Oak weighs about three and a half pounds.

Kaneelhart, in its green state, sinks in water, and even when thoroughly seasoned by scientific machines it barely floats, just the upper surface of a small block breaking the surface of the water.

Professor Wangaard compared Kaneelhart density to that of the heaviest masonite, a compressed wood fiber. It is so strong that he views the wood as an admirable "column load" timber for building supports.

Plastic Pipe

AS the result of an eight-month sea test aboard a destroyer escort, the U. S. Navy plans to install plastic piping in several minesweepers now being built, the Navy Bureau of Ships disclosed recently.

Copper and nickel are used extensively in present shipboard piping systems where corrosion resistance to sea water is essential. In the mine sweepers where the plastic installation is planned, about two tons of copper and nickel will be saved. In addition, there will be savings in copper-brass piping. The following advantages were cited for the use of plastic piping:

Installation costs promise to be considerably less with plastics, once quantity production is begun. The cost of 2-in. plastic pipe of $^1/_4$-in. thickness will be about 70 cents a ft, while similar-size copper-nickel pipe costs about $1.55 a ft, and stainless-steel pipe costs about $2.25 a ft. Black steel pipe, which corrodes and therefore is not used for sea-water piping except in times of great material shortages, costs 55 cents a ft.

Maintenance costs should also be less. The tests aboard the destroyer escort have indicated that for many purposes plastics outlast metal. Even in compartments where the air was very hot the plastic pipes did not corrode or burn. Several pieces of plastic pipe were installed just above the boiler drum, where the air temperature reached 180 F. After eight months of service aboard the destroyer escort, this pipe was not affected.

Plastic pipe also does not corrode from salt water and is resistant to shock. Sections of plastic pipe carrying salt water under pressure were installed just aft of the forward guns. They remained as good as new while nearby steel pipes had to be removed because they were damaged by the combination of corrosion and shock.

The chief engineer of the destroyer escort also reported that during a storm, in which the pipe was subjected to severe stress and vibration, the plastic pipe was not visibly damaged. Several metallic pipes, however, gave way.

Plastic pipe was installed in representative places throughout the destroyer escort for purposes of the test. Norfolk Naval Shipyard did the installation work under guidance of the U. S. Naval Engineering Experiment Station at Annapolis. For example, plastic fire-main piping $^3/_{16}$ in. thick was put in locations where resistance to heat, shock, and average salt-water conditions could be determined.

The commanding officer of the vessel expressed complete satisfaction with the performance of the pipe and forwarded enthusiastic recommendations to the Bureau of Ships.

Plastic material from which the pipes are made is a fiberglas cloth bonded together with synthetic resin. If a leak or break

develops in the pipes, a strip of fiberglas tape can be wrapped around the damaged section and impregnated with plastic. This is expected to prove a quick and practical way to make permanent repairs.

Plastic pipe sections are joined together, not by means of threads, but with sleeves which are slightly larger (0.006 to 0.012 in.) than the pipes. The clearance space is filled with synthetic resin and allowed to harden. No joint developed a leak during the service tests, it was reported.

Tests run on the destroyer escort proved the serviceability of plastic pipe, but some problems of installation must still be solved. For example, techniques are needed which will permit resins used to join the pipes to be applied in all temperatures. As yet, they have a tendency not to harden in cold weather.

Also, metal socket fittings must still be used for joining the plastic pipe. Thus far, the plastic fittings used have been hand-made, and consequently difficult and slow to manufacture. These problems are now being studied by engineers of the Bureau of Ships.

Coal Structure

NEW facts regarding the structure of coal have been discovered by the U. S. Bureau of Mines, Pittsburgh, Pa., as the result of several years of specialized study, it was reported by the Department of the Interior.

The study revolved around the dispersion of coal in solvents at high temperatures and the carbonization of coal to coke.

Some of the results were as follows:

A noncoking subbituminous coal became a coal with good coking properties after it underwent catalytic hydrogenation "under comparatively mild conditions." Tin, zinc, and impregnated iron catalysts were used.

A good-quality coking coal lost its coking characteristics when treated with perbenzoic acid.

When a coal lost its coking qualities through exposure to air, its coking properties were restored nearly to the original by hydrogenation. However, coking properties lost by the perbenzoic-acid treatment could not be restored.

The findings are reported in "Bulletin 505—Studies of the Extraction and Coking of Coal and Their Significance in Relation to Its Structure."

According to the bulletin, in some of the tests, 95 per cent of the organic material was extracted from the coal, thus pointing to a possible commercial method in preparing low-ash carbonaceous material for manufacturing electrode carbons, now in wide use by industry.

Although coal is an absolute essential to the United States in producing steel, chemicals, and other indispensable materials, the report indicated that the true structure of this fuel "is only poorly understood" despite many decades of research.

This situation is due, in part, to the fact that coal consists of complex, organic, collodial systems that are not very soluble in inert solvents, so that most of the classical techniques for structural investigations are inapplicable, the report states.

Copies of the report can be obtained only from the Superintendent of Documents, U. S. Goverment Printing Office, Washington, 25, D.C., for 20 cents per copy. It is not for sale by the Bureau of Mines.

Rapid Camera Shutter

A NEW camera shutter, the Rapidyne, which is claimed to be two to three times faster than any mechanical interlens camera shutter today, size for size, has been developed at Fairchild Camera and Instrument Corporation, Jamaica, N. Y. The device, which is being built for the Air Force and Navy, is actually two shutters—one opens and the other closes almost instantaneously. Company officials say that the new shutter will more than double the speed of the Air Force's K-38 Fairchild reconnaissance camera.

Several Rapidyne models with $^1/_4$-in and 0.8-in. lens openings are said to reach speeds of $^1/_{1000}$ sec total time. In terms of effective exposure time, the system used for rating speeds of commercial and amateur camera shutters, this is almost $^1/_{2000}$ sec. All military shutter speeds are rated on the total time that the shutter is open, which is what freezes motion in a photograph. Effective exposure time is based on the amount of light passing through the open shutter.

Fairchild plans to build nine shutter models for its military cameras with lens openings from $^1/_4$ in. to 7.2 in.

Secret of the new device is application of shutter force in one direction on each set of shutter blades instead of the push-pull technique employed in the conventional single shutter. This also permits the Rapidyne to use lighter shutter leaves, which increase its speed still further and give it longer life.

Another advantage is the timing mechanism, which is said to be smaller, more accurate, and less subject to wear, because it only has to trip the single-direction shutter blades.

The new development, while a precision device, is said to be rugged enough to resist severe shock and vibration, salt-air corrosion, wide temperature extremes, and high altitudes.

In conjunction with moving film, the new device will permit more accurate aerial photographs at the jet-plane speeds of modern warfare. It is pointed out that sharper aerial photographs enable Air Force photo interpreters to detect more easily camouflaged antiaircraft guns, troop concentrations, and fortifications.

Rapidyne inventor, Frederick P. Willcox, Mem. ASME, Fairchild vice-president and research director, stated that the shutter would be installed as rapidly as possible in many Air Force and Navy cameras now on order with the firm.

Mr. Willcox also pointed out that there is almost no shock in starting and stopping the shutter. He said that the new shutter provides for accurate remote control of shutter speed without need for a complex servomechanism.

Another feature of the shutter is its thinness. One model built for use with the Metrogon lens is only 0.070 in. thick. As a result, many sizes are of drawer-type construction. This permits the new shutter to be inserted and removed from a camera without disassembling it or disturbing the lens alignment. Since the precision parts of aerial camera shutters require periodic cleaning and maintenance, this reduces the number of cameras that must be removed from service for overhaul and lens recalibration, a valuable feature in combat areas.

Atomic Energy Report

ACCORDING to the Eleventh Semiannual Report of the Atomic Energy Commission, the six months from July to December, 1951, have been a period of intense activity in the Nation's atomic energy program, with three main lines of work proceeding simultaneously.

Existing plants have been operated at full capacity, and the existing research establishments have devoted extraordinary effort to the extension of basic knowledge and the solution of developmental problems in nuclear science and engineering.

At the same time the large expansion of plant, previously authorized, proceeded with 3 per cent of the nation's total building expenditure in the period going to atomic-energy facilities, and nearly 2 per cent of the nation's construction force employed on AEC jobs.

Meantime, the Department of Defense and the AEC carried on an intensive study of the feasibility of undertaking a further important expansion of atomic-energy-production facilities.

Major developments of AEC programs, during the 6 months covered by the report, may be summarized as follows:

Deliveries of uranium concentrates from the Belgian Congo and Canada continued according to schedule. Domestic production increased as a result of expanded exploration, higher prices for uranium ores and bonuses for initial production, the opening of new producing areas, and increased processing capacity. Various steps were taken for development of new sources of raw materials here and abroad.

The production of fissionable materials continued to increase with a lowering of unit costs. Unit cost reductions were made in spite of increasing labor and material costs and were the result of continuing improvement in production processes and expanded volume of operations. Construction proceeded on or nearly on schedule at most of the major new production facilities. Valuable time was lost, however, at the Savannah River, S. C., Dana, Ind., and Paducah, Ky., projects. Material shortages and labor disputes were the principal contributors to these delays.

Production of atomic weapons continued in accordance with schedules set by the President. Substantial advances were made in weapon research and development. These advances have been accelerated by the continuing test programs made possible by the activation and use of the Nevada testing site.

Progress toward new types of nuclear reactors for making fissionable materials and producing power for military and industrial purposes was signalized by a number of events. In this period the Experimental Breeder Reactor was put into operation at the Reactor Testing Station in Idaho. Utilizing heat energy produced by this reactor, small amounts of electric power were generated on an experimental basis. The Commission continued with the development of the reactor for the first nuclear-powered submarine, and new industrial contractors were enlisted in the work of developing a nuclear power plant for an aircraft.

The reactor development program is the frontier of a new technology in which American industry is showing a decided interest. The developments were encouraging in this sector. Two reports resulting from the studies of the four industrial teams who have been appraising the possibilities of industrial participation in the reactor field on a competitive basis were received and are being studied by the Commission. Private industry was asked to undertake, on a competitive basis, the task of supplying AEC with zirconium, a material uniquely suited for reactor structures. Scores of industrial concerns began to take an interest in and to study on their own the possibilities of putting to work the large sources of radiation that now lie fallow in the wastes from reactors.

In August the Community Operations Panel submitted to the Commission its report and recommendations on private-property ownership and municipal self-government in Oak Ridge, Tenn., and Richland, Wash., and these were issued to the public of the two communities. The Commission has had sample appraisals made and will obtain the reaction of the residents before taking definite action. The Panel's report on Los Alamos is not yet completed.

A closer relation between physical research under contract and the immediate aims of the atomic-energy program developed during this period. Six particle accelerators for research came into operation and five others were being constructed.

New knowledge was gained on the effects of radiation and an increasing variety of radioactive substances on life processes in man, animals, and plants. Development of methods of protecting people from radiation continued to be one of the major objectives. To better understand the hazards of atomic warfare, studies of the immediate and genetic effects of radiation on living tissues were continued.

In October, the Congress enacted an amendment to section 10, the first major revision of the Atomic Energy Act of 1946. This amendment will permit exchange of certain information with other friendly governments under adequate safeguards where such an exchange can be shown to be beneficial and not prejudicial to the national interest. Other proposed amendments were submitted by the Commission for the consideration of the Joint Committee on Atomic Energy.

Fifty-seven licenses were issued to industry to use the patents owned by the Commission. The Patent Compensation Board made its first award on a patent.

Brookhaven Research Reactor

CERTAIN structural details of the Brookhaven reactor at Brookhaven National Laboratory, Upton, N. Y., recently have been released by the U. S. Atomic Energy Commission. The laboratory is operated by Associated Universities, Inc., under contact with the AEC.

The announcement follows removal from secrecy classification certain data of the reactors at Brookhaven and Oak Ridge National Laboratory, in Tennessee (MECHANICAL ENGINEERING, March, 1952, pages 228 and 229). Both are low-power

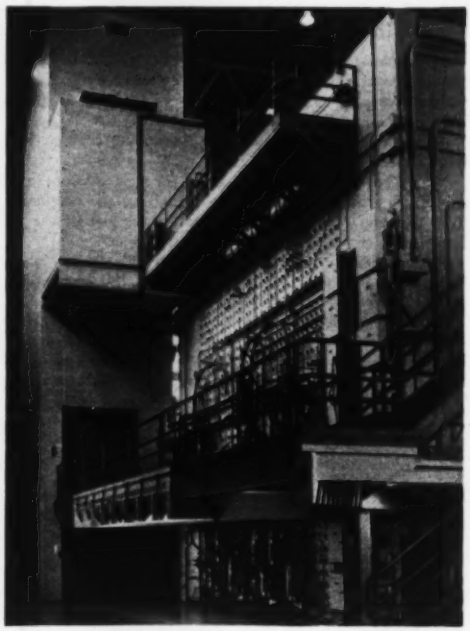

FIG. 7 NORTH FACE OF BROOKHAVEN REACTOR

(A pneumatic-tube system which occupies most of the north face is useful in making radioisotopes of short half life which lose half their radioactivity in seconds, or minutes. Deliveries can be made either to this face of the reactor, or directly into one of several adjoining laboratories, for use in connection with special experimental equipment. The tall column at left houses a freight elevator for transporting heavy experimental equipment to the many working levels at the reactor.)

FIG. 8 EAST FACE OF BROOKHAVEN REACTOR

(View of experimental equipment at east face, white wall on left. In center experiment, a beam of neutrons comes out of the reactor face, and is reflected by a mirror. Reflected neutrons are then detected by a bank of counters inside the shielded array, center. Neutron counts are recorded on the panel at right, which also supplies voltage for the counters. In the background, behind shielding, is a slow neutron chopper. This instrument selects neutrons according to their speeds. It consists of fast-rotating disks with openings arranged so that only neutrons of a certain speed will pass through, other neutrons being absorbed by the metal of the disks. The apparatus mounted on the reactor face at far left is a conveyer for moving samples of materials inside the reactor for exposure to neutrons. The materials are so altered by such exposure that they become radioactive. These radioisotopes have many uses in science, industry, and agriculture.)

reactors designed for research and production of radioisotopes, rather than for practical production of materials for atomic weapons. The Brookhaven reactor is the nation's largest research reactor and the only reactor in northeastern United States.

Declassification is intended to "advance the art" of reactor technology by assisting industrial concerns and universities now studying the feasibility of constructing their own reactors, for research or for production of energy which can be converted into electric power.

One side of the Brookhaven reactor, the west face, is available to all qualified scientists upon approval by the director of Brookhaven and by the AEC. The rest of the reactor is accessible only to persons with AEC security clearance (based on an FBI investigation). Until distribution of photos of all four sides, a photo of the west side was the only photo of the reactor itself available for publication.

The reactor proper is a 25-ft cube composed of some 60,000 pieces of graphite. Actually, however, the cube is split vertically in the center to provide a gap into which the thousands of cubic feet of air used to cool the reactor are introduced. After the air circulates through each half of the cube, it is collected in two spaces called plenum chambers before being discharged.

The cube and chambers are enclosed in a concrete shield five feet thick. Thus the overall width is 38 ft, including shield, graphite, and center space between. The length is 55 ft, including shield, two plenum chambers, graphite, and central air gap.

A reactor of the Brookhaven type can be thought of as an "atomic furnace" in which graphite is the housing and uranium metal the "fuel" which "burns," or fissions, in a chain reaction. Tons of pure uranium metal are loaded through the holes of the south side, or face, of the Brook-

FIG. 9 WEST FACE OF BROOKHAVEN REACTOR

(The security walls, far left and far right, seal the area off so that it can be used by scientists for experiments without revealing classified data from other parts of the structure. On the first balcony, physicists and chemists are performing typical experiments with spectrometers for measuring the energies of neutrons in beams emerging from the reactor. The round ports or openings can be used either to let out such beams or for inserting substances to be made radioactive inside the reactor. On the ground floor and on the second balcony are health physicists with equipment for monitoring the ports, to make sure that background radiation is kept below tolerance levels. In the right foregound is one of the steel and concrete plugs used to seal off openings on the top of the reactor. The top, all four faces, and the bottom of the reactor, reached by tunnels, can be used in experiments.)

haven reactor before uranium atoms can fission, or split, in a chain reaction (see frontispiece on page 274 of this issue). The reaction releases atomic particles, known as neutrons, for use in experiments and for production of radioisotopes.

This side of the "furnace" is the loading face. It contains holes in rows and columns 8 in. apart. Most of the holes accommodate long aluminum cartridges, each containing uranium. Many of the holes are used to insert certain types of metals and other substances to be irradiated by neutrons. Some of these materials emerge with radioactivities of thousands of curies of beta and gamma rays, forms of radiation now used in industry and agriculture.

A pneumatic-tube system occupies part of the north face of the Brookhaven reactor, Fig 7. The system can be compared to a change-making device in a department store which can whisk paper money from a counter to the office and the change back to the customer. Here, a sample of a material in a container can be inserted into one of the tubes and sped into the reactor, for bombardment by neutrons. It is quickly returned, now radioactive, for use in experiments.

Samples are also inserted at the east face for conversion into radioisotopes. However, both the east and west faces, Figs. 8 and 9, are used primarily for experiments in which neutron beams are let out through special openings for studies of the properties of neutrons themselves, or of materials they strike. Such studies can add to understanding of the nature of matter.

Fractional-Horsepower Motors

THERE are at present 700-odd home, industry, and farm applications for the 40 million a year production of fractional-horsepower motors—and the figure is ever rising. Every year new methods are devised which find increasing uses for these motors. Coupled with this increased use are the factors of growing population and renewal of worn-out equipment which tend to multiply the market even more. Market studies indicate that the fractional-horsepower-motor business in 1960 will be approximately double that of 1950.

It was found that while evolutionary improvements had been made as new technologies were developed and better materials became available, General Electric Company motors were basically the same as those turned out in the early 1930's. It was still a good motor and serving dependably and economically in millions of installations throughout the world. But it was decided, logically, that there must be some basic elemental areas in which this motor could be made even better. Standardization is one thing—static design another.

Immediately following the war, therefore, design engineers of General Electric's Fractional Horsepower Motor Department at Fort Wayne, Ind., were presented with a bold challenge: To develop an entirely new line of motors embracing all the qualities and characteristics most sought after by the tens of thousands of users. A nationwide survey covering small motor users in every field was conducted, and the results clearly indicated that, while existing fractional-horsepower motors were performing efficiently and dependably in thousands of exacting applications, there were three major areas where improvement could be made:

1 Size and weight—users were unanimous in seeking smaller, lighter motors.

2 Usability—greater flexibility of application for standard types was desired.

3 Appearance—manufacturers, particularly those in the appliance field, sought a "handsome" as well as functional drive.

The result was the development by G.E. of a new line of fractional-horsepower motors embodying an entirely new concept of motor design and manufacture.

Designated as "Form G," the new motors are the result of nearly a decade of developmental engineering and research, and incorporate many radically different and advanced design features.

According to G-E engineers who worked on the project, the Form G motor weighs as much as 51 per cent less per horsepower than the models it replaces, and is considerably smaller in size. At the same time, its versatility of application has been broadened and its appearance modernized.

The motors are available in open drip-proof and totally enclosed fan-cooled models in Types K (polyphase), KC (capacitor start), KH (split phase), and KCP (permanent split capacitor). These have hundreds of applications—on pumps, fans, blowers, compressors, office and home appliances, motorized tools of all sorts, etc. The design principles ultimately will be adapted to motors for more specialized uses as the Form G line expands, the engineers said.

The Form G makes more efficient use of new and existing materials, and features a long list of design "firsts." Among these are new bearings, lubrication system, insulation, ventilation, mountings, windings, end shields, terminal board, and leads.

For example, results of ventilation-system studies proved that for standard 4, 6, and 8-pole motors, double-end ventilation was the most effective and efficient. Here, fans and a complete ventilation assembly were provided for each end of the motor, the first true double-end system ever used on motors of this type.

In the case of the relatively higher-speed 2-pole motors, through ventilation proved to be best. In this system, air is drawn in at one end of the motor through passageways over the stator core and exhausted at the other end.

For totally enclosed motors, a completely self-contained fan-

FIG. 10 DIFFERENCE IN WEIGHT OF NEW G-E FORM G FRACTIONAL-HORSEPOWER MOTOR, LEFT, AND AN OLDER FORM B MOTOR OF EQUIVALENT RATING IS SHOWN BY BALANCE

cooled design was developed for the first time. In this design, an internal ventilation system provides for effective heat transfer to the motor shell, and a separate system—sealed off from the first—washes the outer surface of the motor with a constant stream of air. Because of this design innovation, it is now possible to build all ratings of open motors in the same frame diameters as totally enclosed motors.

For sheet-type insulation—that is, slot liners and phase insulation—nylon is being used. It is probably the first time in history that this tough, heat-stabilized, and extremely moisture-resistant material has been used on standard production-line electrical equipment. Combined with Formex insulated wire and Glyptal varnish, nylon provides an insulation which—if the results of accelerated life tests are any indication—will be as good after fifty years of use as it is when brand new.

Although no increase in recommended maximum temperature is being advocated, it is obvious that this new insulating system will significantly improve the factor of safety in so far as abnormal conditions and accidental overloads are concerned, the engineers said.

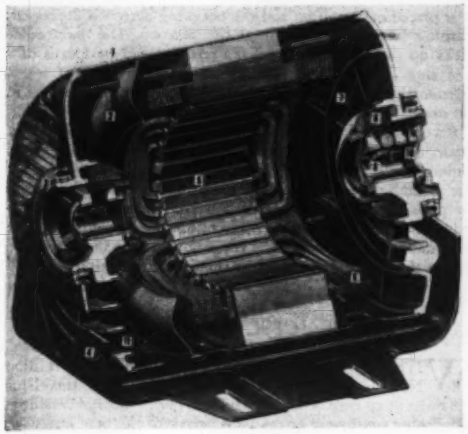

FIG. 11 CUTAWAY VIEW OF FORM G MOTOR

(1, Steel stator shell; 2, baffle ring; 3, double-bonded resilient ring to isolate noise; 4, steel-cradle base; 5, stator core; 6, unified insulation system; 7, flat disk-type end shields; 8, felt wickings; 9, sleeve bearings; 10, external oil thrower; 11, ventilating openings.)

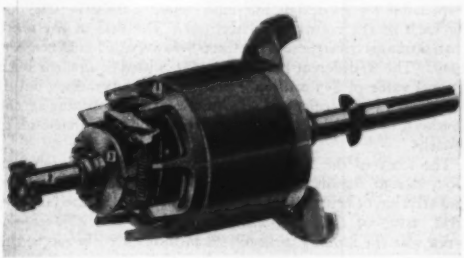

FIG. 12 VIEW OF FORM G ROTOR ASSEMBLY

(1, Aluminum rotor winding; 2, locking device; 3, centrifugal mechanism for maintaining correct alignment.)

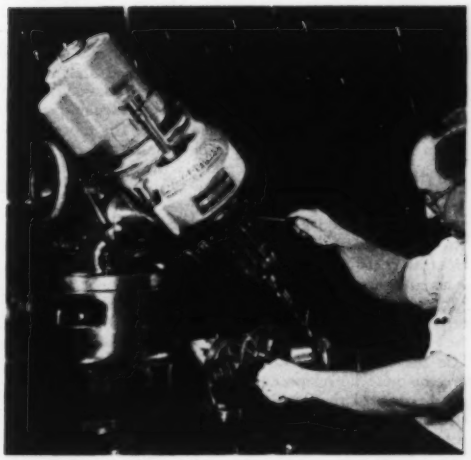

FIG. 13 NEW G-E TOTALLY ENCLOSED, FAN-COOLED, 1/2-HP, FORM G MOTOR SHAFT-MOUNTED ON A MACHINE TOOL

(The Form G TEFC motor may be rotated in any position and still retain its protective feature of keeping out dust, dirt, and other matter.)

The Form G motor is said to be the first general-purpose, sleeve-bearing motor designed for all-angle operation and is capable of handling normal thrust loads in any direction. This is made possible by a sleeve and thrust bearing design, in which provision is made for complete oil retention and recirculation regardless of the position of the bearing or the direction of the load. Oil capacity of these new bearings is more than 50 per cent greater than present designs, and improved oil-retaining and transmitting materials increase the flow of lubricants to the bearings.

Totally enclosed fan-cooled as well as dripproof models of the new motor are built in both sleeve-bearing and ball-bearing general-purpose types. The ball-bearing construction, for extra-heavy thrust loads, is protected by a large grease supply which can be renewed with a grease gun without disassembling the motor. An automatic pressure-relief fitting permits re-greasing without overloading the bearing.

Other components of the new motor have also been designed with the three basic objectives—size and weight, usability, and appearance—in mind.

The steel stator shell is lightweight, strong, precision-machined; assures permanent true alignment. Its surface is phosphatized for corrosion protection.

A new approach in base construction is provided in that both solid and resilient mounted motors are suspended on trunnions surrounding the bearing at each end of the motor. This "suspension" technique permits quiet operation; increases the motor's resistance to damage.

Flat disk-type end shields of die-cast aluminum, especially ribbed and reinforced for extra strength, provide the rigidity necessary to withstand the stresses of heavy radial and end-thrust loads.

The stator core, of welded construction, is also finished to close tolerances, but is kept slightly larger than the inside diameter of the stator shell. In assembly, therefore, the shell is expanded slightly, within its elastic limits, to receive the core. The result is a sturdy assembly that has been proved immovable by repeated drop and shock tests.

In contrast to previous fractional-horsepower-motor practice, all of the electrical components of the new motor, the starting switch, protective devices, etc., are housed within the protective shell for easy and safe assembly and disassembly. All wire connections are made independently of the end shields.

The aluminum rotor winding is made by a vacuum-pressure casting process new to the motor industry. The process produces a denser winding resulting in more uniform performance. Large ventilating fins, cast integrally with the winding, provide the maximum amount of air flow within a relatively small space.

An easily removed locking device holds the rotor in place. This device, together with the thrust-washer assembly, maintains correct end play, absorbs moderate thrust loads, and needs no maintenance.

The centrifugal mechanism is pressed on the shaft to assure correct alignment and proper contact spacing for smooth positive action.

On the average, with these new motors, approximately 50 per cent more horsepower output per pound of material can now be realized than could with the former motor line (the latter being a fair representation of the fractional-horsepower-motor industry as a whole). In other words, an appreciably greater number of motors can now be produced from a given allotment of material than ever before. With every indication of a continuing "guns-and-butter" economy, this means that the ultimate consumer may be able to purchase a motor-driven appliance, a furnace, fan, washing machine, refrigerator, or even an electric typewriter that otherwise would be unobtainable.

Miniature Telegraph Machine

A MINIATURE facsimile telegraph machine which takes up less than a square foot of space on the desk of a businessman, was described by G. H. Ridings and R. J. Wise, research engineers of the Western Union Telegraph Company at the winter meeting of the American Institute of Electrical Engineers in New York, N. Y. Called the Desk-Fax, this self-contained telegraph office sends and receives telegrams instantly and automatically in picture form simply by pushing a button.

The Desk-Fax, designed to improve the speed and efficiency of telegraph service and make it more convenient and attractive to the public, is being installed in many cities as a part of Western Union's $100 million nationwide plant-improvement program. Five thousand Desk-Fax machines are scheduled for installation in 1952, to bring the total to 10,000 in service.

FIG. 14 MINIATURE DESK-TYPE TELEGRAPH MACHINE

Telegrams may be sent or received over the machines at any time, day or night. No carbon is necessary since the sender retains his original message after transmission. Telegrams sent and received by Desk-Fax are charged for at regular telegraph rates.

The telegram to be transmitted on the optical Desk-Fax is typed or handwritten on ordinary paper of the proper size. It is placed on the drum and the outgoing button is depressed; nothing further is required of the patron. The main office picks up the call with a Telefax recorder and by means of a line signal starts transmission. Upon completion of transmission the machine automatically shuts down and returns to the normal stand-by condition.

Receiving a telegram with the Desk-Fax is equally as simple. Upon receiving a buzzer call, the patron places a Western Union "Teledeltos" receiving blank on the drum, depresses the incoming button, and after reception acknowledges receipt by pressing the accept button. If the wrong button is accidentally pressed in either reception or transmission, the machine will not function. The stop button can be used to restore the machine to a stand-by condition at any time.

New Jersey Turnpike

WITH completion in January, 1952, of the $255 million New Jersey Turnpike, motor vehicles can travel for 118 miles at an even 60 mph from New York's George Washington Bridge southwest across New Jersey to the new Delaware Memorial Bridge near Wilmington, Del. Because the road cuts through one of the most densely populated and heavily industrialized areas in the country, right-of-way costs were high and engineering problems were aggravated. Financed by revenue bonds without federal or state aid, this toll expressway is self-liquidating. Seven engineering firms were made responsible for its design and supervision of construction, one for each of the construction sections. The first of the more than 80 major construction contracts was awarded in December, 1949. The 50 different prime contractors used equipment with a total value of $45 million. Simultaneous operations on all sections and an accelerated schedule led to the opening of the southern 93 miles in November, 1951, in the record time of 23 months.

The story of the New Jersey Turnpike, including construction, design details, and specifications; design, fabrication, and erection of bridges, and the like, is featured in the January, 1952, issue of *Civil Engineering*. Involved in the Turnpike work was the moving of nearly 52 million cu yd of earth, the building of 260-odd structures, five of them major bridges; and the laying of almost 7 million sq yd of pavement, including the shoulders.

Ignitron Locomotive

IN a paper presented before the winter meeting of the American Institute of Electrical Engineers in New York, N. Y., C. C. Whittaker and W. M. Hutchison, transportation engineers of the Westinghouse Electric Corporation, described the new ignitron-rectifier locomotive, which, they said, combines the economy of an a-c power supply with the simplicity and higher starting power of d-c motors.

The principal deterrent to railroad electrification in this

country is its high first cost, Mr. Whittaker said. He pointed out that the ability of a rectifier locomotive to operate at commercial frequencies of 50 or 60 cycles, as compared to a frequency of 25 cycles now required by a-c motor design, offers the possibility of reducing electrification costs and widening the field in which it is economically justified.

Electrified railroads faced a complex problem for many years, he said. The d-c motor has distinct advantages over the a-c motor for traction purposes, but the transmission and distribution costs of direct current are necessarily high.

The alternative was to use the somewhat less efficient (for the purpose) a-c motor, or install bulky, expensive motor-generator sets in the locomotives to convert the alternating current into direct current for the driving motors.

The new locomotive utilizes ignitron rectifiers. By means of graphite electrodes and a pool of mercury, they readily convert alternating current into direct current.

Mr. Whittaker reported that one 6000-hp ignitron-rectifier locomotive is in actual service, and another similar locomotive is undergoing tests on the Pennsylvania system. Each develops about 60 per cent more tractive effort than a standard three-unit Diesel-electric locomotive. An electric locomotive equipped with a-c motors has an advantage in the high-speed range, and the rectifier locomotive produces almost 50 per cent more tractive effort in the low-speed zone.

V-2 Rocket Tests

FIRINGS of V-2 rockets in White Sands, N. M., tests over the last five years demonstrated that simplicity of design bears directly upon reliability, according to Dr. R. W. Porter, who directs Project Hermes, a joint General Electric-U. S. Army Ordnance guided-missile project. He spoke before a group of military and civilian rocket specialists at the Army's Redstone Arsenal, in Huntsville, Ala.

Useful information in aerodynamics, parachute design, atmospheric properties, and other fields was obtained in 45 of these firings—a higher ratio of good to bad rounds than predicted by German scientists who were interrogated at the start of the program. In fact, the over-all performance of the missiles was better than normally obtained by the Germans despite the age of the rockets and the inexperience of the U. S. firing crews.

Dr. Porter was a member of one of the technical intelligence teams which ranged through Germany close behind the Allied army gathering V-2 rocket parts and data.

The teams first contacted scientists working on the V-2 program at Darmstadt, where one of the greatest aeronautical schools in Germany was located. At Garmisch-Partenkirchen they found the scientific staff of the German's Peenemuende rocket experimental test station, which had moved to the Bavarian Alps when the Russian army cut across northern Germany.

The underground V-2 production lines were found at Nordhausen and Bleicherode (now in the Russian occupation zone). The rockets were gathered in this area by crews working without parts lists and sent to the United States.

In addition to carloads of rocket parts and data, the teams rounded up many of the German rocket scientists and their families, and sent them to the United States where they formed the nucleus of this country's V-2 firing program. In all, about 100 rockets were sent by these teams to the United States.

The first American flight of a V-2 was made on April 16, 1946, just a month following a test run of the rocket motor. The joint Army Ordnance-General Electric program was terminated last July.

During that period, eight of the V-2's were fired as two-step or "bumper" rockets in which a smaller rocket, the WAC Corporal, was carried in the nose of the larger rocket and fired at burn-out of the V-2. One of these set an altitude record of 250 miles and a speed of about 5000 mph.

Dr. Porter credits much of the success of the firings to the over-all planning of the V-2 panel. An informal organization, it represented various interested agencies which wanted to get certain kinds of information from the V-2 flights.

General responsibility of the panel included setting up the firing program and assigning rockets to the participating groups. Once assigned, the rockets became the "property" of a particular group, which then had the responsibility for the instrumentation and firing.

With the firings came the following new knowledge:

1 Two-stage rockets.

2 Aerodynamics. These experiments revealed valuable information on heat transfer, drag caused by base-pressure distribution, and boundary-layer transition.

3 Atmospheric conditions. Pressure, temperature, and density of the upper atmosphere were measured by the V-2. In one experiment, an exploring probe was used to measure the position of the shock wave at the V-2 nose. This determined the Mach number of the vehicle; the true velocity was determined from the Doppler record. Knowing true velocity and Mach number, the temperature of the surrounding air was calculated.

4 Atmospheric qualities. Composition of the atmosphere was found using sampling bottles.

5 Ionization. Ion densities in the E1 and E2 layers of the atmosphere were measured. Radio propagation tests were also made.

6 Radiation. Investigations were also made into the measurement of the earth's ability to reflect light. In these experiments, cosmic radiation, soft x-ray radiation, and the corona temperature of the sun were measured.

7 Earth's magnetic field. Pioneer work was begun with the V-2, though Martin's Viking rocket is now active in this field.

8 Parachute design. Parachute techniques at supersonic speed were studied. At these speeds the generated temperatures are enough to melt nylon chutes.

9 Meteors. Sensitive microphones, broadcasting back to ground observers, were used to pick up the pinging sound as the rocket collided with bits of meteors. The effects of meteor dust collisions were measured by uncovering polished plates at altitude.

10 Photography. Both color and black-and-white photographic techniques were studied and for the first time the earth was photographed from extreme altitudes.

11 Television. The Air Force experimented with a 275-line screen. Fifteen of the lines were used for transmitting data, and the remainder for a picture.

Several reports were filed with each firing, according to Dr. Porter. One from the firing crew described the procedure used and whatever trouble shooting was necessary. The analyses, he said, taught more about the design and use of rockets than could be learned in any other way.

Of six of the 36 comparatively "bad" rounds, exactly what happened, in what sequence, and with what result, is known; the analyses showed what happened, but not why for another 14 rounds; and for 16 rockets, only the general area of trouble was known.

Propulsion and steering systems were about equally at fault in the misfirings, Dr. Porter noted.

With the experience gathered during the five-year program, he says that in an equivalent program started today total misfires could probably be cut to about four or five

ASME TECHNICAL DIGEST

Substance in Brief of Papers Presented at ASME Meetings

Boiler Feedwater Studies

Correlation of Silica Carry-Over and Solubility Studies, by C. Jacklin and S. R. Browar, National Aluminate Corporation, Chicago, Ill. 1951 ASME Annual Meeting paper No. 51—A-91 (mimeographed).

ATTENTION is directed to the need for a general all-inclusive pattern for the problem of silica carry-over from steam boilers and deposition in steam turbines.

Laboratory studies, in an experimental boiler, of factors which were thought to influence silica carry-over show certain general trends. High ratios of hydrate to silica in the boiler water tend to reduce the ratio of silica in the steam to silica in the boiler water. The presence of calcium sludge, magnesium sludge, antifoam organic treatments, and various combinations of these materials in the boiler water caused no consistent increase or decrease in the ratio of silica in the steam to silica in the boiler water.

The results of previous laboratory experimental boiler studies on the distribution ratio between silica in the steam and silica in the boiler water made by other investigators have been generally confirmed by the authors.

A new approach to the problem is developed to correlate the results of several different investigators.

The approximate solubility of silica in saturated steam has been calculated by combining the data presented by different investigators.

The approximate relationships between boiler pressure, boiler-water silica, silica carry-over, and silica solubility in saturated and superheated steam have all been combined into a single chart.

A correlation is shown between the geological studies of silica solubility in steam at high temperatures and the silica

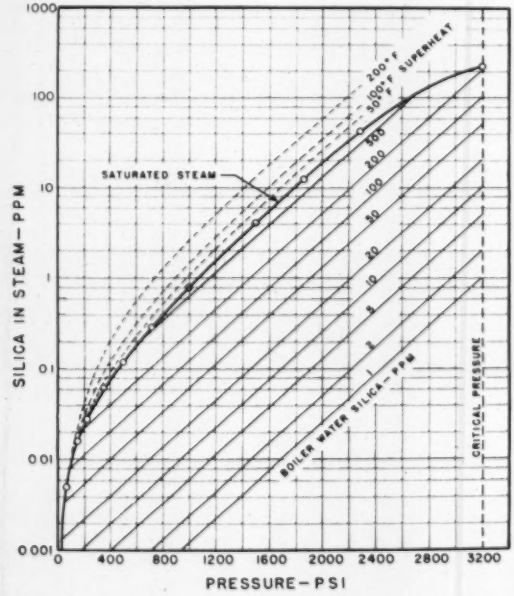

CHART SHOWING APPROXIMATE RELATIONSHIPS BETWEEN PRESSURE, BOILER-WATER SILICA, SILICA CARRY-OVER, AND SILICA SOLUBILITY IN SATURATED AND SUPERHEATED STEAM

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solubilities involved in turbine deposits, when silica solubility is plotted against the density of water and steam.

Many questions still remain unanswered, but it is hoped that the pattern which has been developed will prove helpful in co-ordinating the efforts of different investigators who are working on the problem.

The Influence of Boiler Design and Operating Conditions on Steam Contamination, by P. M. Brister, Mem. ASME, F. G. Raynor, Jun. ASME, and E. A. Pirsh, The Babcock & Wilcox Company, New York, N. Y. 1951 ASME Annual Meeting paper No. 51—A-95 (mimeographed).

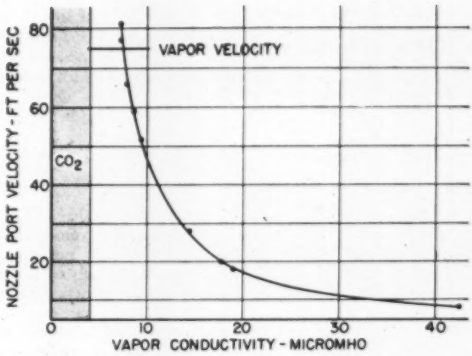
ENGINEERS concerned with steam generation are well acquainted with the problems caused by impurities in steam and the demand for increasingly purer steam which has been imposed by the trend toward higher steam pressures and temperatures in power plants. Improvements in steam-purification equipment have continually progressed with the result that steam with solids contamination measuring as low as 0.3 to 0.6 ppm is quite common today. Even this high order of purity has not eliminated troublesome turbine deposits in all plants and further improvement in steam purity must be achieved.

The improvements which have been made thus far were made possible by recognition of many factors involved in separating steam and water, and designing and proving by test the equipment required to control these factors. This paper discusses such factors and shows how design and operation can affect the resulting separation and steam purity.

Field Testing of Steam Sampling Nozzles as Applied to Evaporator Vapor, by E. B. Morris, American Gas and Electric Service Corporation, New York, N. Y. 1951 ASME Annual Meeting paper No. 51—A-94 (mimeographed).

BECAUSE of the need for correlation between steam-sampling theory and practice, field tests of sampling nozzles were conducted on evaporator vapor. Results were obtained that in some cases substantiated and in other cases deviated from theory. The trends and limitations of such field testing are discussed and the need for a more versatile and comprehensive test program shown. The basic design of test facilities and broad outlines of such a program are given for an evaporator installation under construction.

The following conclusions may be drawn from the present status of the test program:



EFFECT OF SAMPLE FLOW RATE ON CONDUCTIVITY OF EVAPORATOR VAPOR FOR ASME-TYPE UPFLOW NOZZLE

1 For an ASME-type nozzle in an upflow location one pipe diameter from the evaporator outlet, variations in sample flow rate over a 10 to 1 range gave variations in conductivity of as much as 7 to 1 under certain conditions. Under other conditions no changes in conductivity were observed, leading to a theory that nozzle characteristics may be a function not only of the amount of impurity but to a greater extent of its physical form and nature.

2 Stable operation of an evaporator with controlled carry-over is difficult to secure even for a base-loaded unit of which the evaporator is an integral part of the heat cycle. This constitutes the major difficulty in field nozzle testing.

3 Definite trends have been shown by comparisons between vapor sampled from nozzles and total condensed vapor that would appear to indicate that the nozzles tested may not take representative samples.

4 The present investigation points the way for a more comprehensive test program by illustrating trends to be expected, defining test limitations, and indicating techniques required to overcome such limitations. A comprehensive and versatile installation of test facilities is under construction on the basis of indications of the tests outlined by this paper.

The Spectrophotometric Determination of Small Amounts of Soluble Silica in Water, by H. E. Robison, General Electric Company, Lynn, Mass., E. A. Pirsh, The Babcock & Wilcox Company, New York, N. Y., and Elizabeth J. Grimm, Armour Research Foundation, Illinois Institute of Technology, Chicago, Ill. 1951 ASME Annual Meeting paper No. 51—A-92 (mimeographed).

A METHOD for the determination of silica in steam condensates and boiler waters sensitive to 0.01 ppm is presented.

The method recommends the use of the reduced silicomolybdate complex, the color being measured by a spectrophotometer at a wave length of 815 microinches. The use of 100-mm cells in the spectrometer, silica-free reagents, and optimum color development permit sensitive analysis for silica in the 0.01-ppm concentration range. The influence of pH on color progression characteristics of the complex and elimination of phosphate interference are described.

The primary purpose of this investigation was to make the reduced silicomolybdate determination more reliable and sensitive to small concentrations of silica. In order to establish the lower limit of silica concentration at which siliceous turbine-blade deposits become a power-plant problem, a sensitive test for silica was necessary. Evidence seems to indicate that even concentrations of 0.03 to 0.05 ppm are troublesome. The work was done as part of the over-all research program on "Steam Contamination and Turbine Blade Deposits."

The silica in condensed steam from modern high-pressure boilers will usually vary between 0.01 and about 0.20 ppm.

In general, the silica concentrations in boiler waters will vary between 1 and 15 ppm although some operators will maintain the concentrations at 5 ppm or below. Various interfering ions and coloring matter may be present in boiler water. Condensed-steam samples rarely contain interfering ions in objectionable concentrations. The main concern of this investigation has been the determination of silica in condensed steam; the procedures were established in such a manner, however, that they are applicable to most boiler waters.

Adaptation of the Spectrophotometric Determination of Small Amounts of Soluble Silica in Water to the Determination of Undissolved Forms of Silica, by H. E. Robison, General Electric Company, Lynn, Mass, Elizabeth J. Grimm and C. Brown, Armour Research Foundation, Illinois Institute of Technology, Chicago, Ill. 1951 ASME Annual Meeting paper No. 51—A-93 (mimeographed).

A NUMBER of sources of insoluble silica were investigated for stability of the dispersion and degree of insolubility of the silica. A specially prepared bentonite dispersion was found to be the most suitable for a source of insoluble silica.

Three methods of determining unreactive silicas have been developed, viz., a potassium carbonate fusion in a gold crucible, pressure digest with caustic, and hydrofluoric-acid solubilization. The fusion and pressure digest methods seem to be inherently less accurate than the hydrofluoric-acid solubilization method but are useful as independent check methods.

Cleaning procedures were found for the apparatus used that would result in low and consistent blanks for the hydrofluoric-acid solubilization method. At the present stage of development, this method appears to be capable of analysis for total silica at 0.082 ppm with an accuracy of about four per cent which is adequate for most purposes.

An analysis for a form of silica of intermediate reactivity has been developed. It is done by means of a caustic digestion on a steam bath. This method has almost the accuracy and sensitivity of the soluble-silicomolybdate analysis.

Soluble and total silica analyses of waters from the contaminating deposition apparatus, and typical boiler-water and superheated-steam condensate samples showed no appreciable difference which indicates that all the silica was soluble.

Fuels

Station Design With Cyclone-Fired Steam Generators, by H. C. Schroeder, Mem. ASME, and R. J. Strasser, Mem. ASME, Sargent & Lundy, Chicago, Ill. 1951 ASME Annual Meeting paper No. 51—A-118 (mimeographed; to be published in Trans. ASME).

THIS paper deals with station design where cyclone-fired steam generators are used, and it describes the engineering design features of the installations that are in operation, and also those in the process of construction or design.

The principal factor that led to the development of the cyclone-type furnace was the need for finding better methods for burning Central Illinois coal. This coal is high in ash and sulphur and has a low ash-fusion temperature. Its burning characteristics are such that research for improved methods of burning was a necessity, and therefore led to the cyclone-furnace development. Previous methods of firing permitted a much larger percentage of ash to pass through the heat-absorbing surfaces.

It is concluded that (1) The ash-handling systems are no more complicated for cyclone than for pulverized-coal-fired units. (2) With less fly ash in the discharge gases, smaller dust collectors are required. (3) The gases passing through the boiler sections contain less dust, but the dust with Central Illinois coal is of such composition, high in alkalies, that it sticks to the surfaces. To date there has been no reduction in equipment and labor for cleaning the absorbing surfaces when burning Central Illinois coal. It is hoped that the use of tempering gas and other methods of cleaning will be successful and permit a reduction. (4) The cyclone-fired steam generator permits the use of a smaller unit for the same capacity, compared with other methods of combustion. (5) The cost of preparing coal for burning, both from the power and maintenance standpoints, is considerably less than for pulverizing coal. (6) The elimination of induced-draft fans on the large generating units has not been made, but it is hoped that this will become a possibility in the not-too-distant future. Smaller industrial boilers with cyclone furnaces are now operating successfully without induced-draft fans. (7) The cyclone-fired boiler takes approximately 10 per cent less floor area and 25 per cent less volume. This study was made for a boiler of 1,200,000 lb per hr capacity at 1800 psig, 1050 F throttle temperature, and 1000 F reheat steam. The boiler is used with a 150,000-kw turbine generator unit.

Diesel Fuel Performance, by R. W. Van Sant, Jr., Gulf Oil Corporation, Pittsburgh, Pa. 1951 ASME Annual Meeting paper No. 51—A-140 (mimeographed).

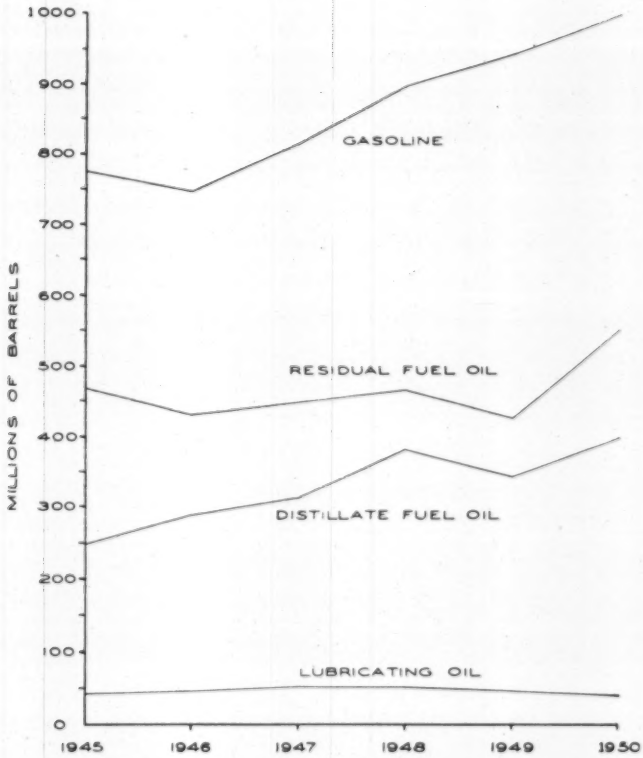
THE general justification of the Diesel engine over other prime movers for a particular application lies in its ability to produce the required power at a lower over-all cost. Features of the required power unit such as desired horsepower, initial installed cost, reliability, weight and size limitations, maintenance, fire hazard, exhaust gases, water supply, available fuel, and other specialized considerations, further limit the type of required power. During the last 20 years the Diesel engine has met these requirements in an increasing number of instances. This has been achieved through the continual improvement of the balance of Diesel-engine design with fuel and lubrication-oil characteristics coupled with the proper operating and maintenance technique.

The petroleum industry supplies the latent energy for the Diesel engine as Diesel fuel, which is one of a number of petroleum products used as a source of energy.

Current production of gasoline is in the order of 2 times that for residual fuel and $2^1/_2$ times that for distillate fuel oil. The increasingly higher demand for all petroleum products which are now produced at a rate in excess of 2 billion bbl per year has been achieved by the American petroleum industry through increased crude-oil production and refining capacity. This increase in demand for crude oil, which now approaches 7 million bbl per day, forces the acceptance of a wider range of crude-oil characteristics by refineries. Under these limitations more frequent incidences of high sulphur content and other components are noted in the finished distillate and residual fuels.

The rapid increase in demand for both the volume and higher quality of gasoline, which is now produced at a rate of approximately 1 billion bbl per year in the United States, has been achieved through an increase of refining capacity and an expansion of catalytic-cracking facilities. The importance of the catalytic process and its advantage over the thermal cracking method is indicated by the 1950 capacity of approximately 800,000 bbl per day which is more than twice the 1945 catalytic-cracking capacity and more than the capacity of the older thermal cracking method. During this same period thermal cracking capacity has remained relatively constant. The high-quality gasoline stock from the catalytic-cracking process, coupled with the use of tetraethyl lead, has resulted in a national increase of gasoline quality which, in part, is reflected by the research octane-number increase for premium gasoline from 86 in 1947, to 90 in 1950. This has made possible the widespread use of more economical high-compression automotive gasoline engines which are undergoing further improvement by design changes to gain mechanical octane numbers. These additional design improvements are essential to secure the optimum performance from high-quality gasoline and broaden the gasoline quality acceptance range of the engines.

The charging stock generally used for the catalytic-cracking process is in the boiling range of 500 to 1050 F. This in-



PRODUCTION OF PETROLEUM PRODUCTS IN THE UNITED STATES

cludes part of the boiling range of 360 to 650 F from which light heating oil and Diesel fuels are frequently produced. Theoretically, it would be possible to convert all of the stock in the 360 to 650 F range to lower-boiling high-octane fractions by the catalytic-cracking process; however, this high conversion is not normally practical. In general, the products from the catalytic-cracking process are gases, gasoline stock, tar, coke, and catalytic-cracked intermediate distillates.

A large portion of these distillates lie in the boiling range of light heating oil and Diesel fuel and are needed to replace or supplement the straight-run distillates. In general, these cracked intermediate distillates have a lower API gravity, higher aromatic and olefin content, and lower cetane number than the comparable boiling range of the stock originally charged to the cracking process. Depending on the boiling-range distribution of the sulphur compounds in the crude, some increase in the sulphur content of the intermediate distillates may be effected through the boiling-range redistribution of the cracking process.

These catalytic-cracked distillates are usually blended with straight-run, uncracked distillates to produce light heating oil and Diesel fuel. In some instances the cracked distillates are used directly as light heating oil or Diesel fuel. When properly treated for storage stability, these cracked distillates and blends of cracked and straight-run distillates make excellent light heating oil and good Diesel fuel for large engines and high-speed engines in many types of service.

Impact of Defense Activities on Petroleum Fuel Supplies, by Adam K. Stricker, Jr., Mem. ASME, General Motors Corporation, Detroit, Mich. 1951 ASME Annual Meeting paper No. 51—A-148 (mimeographed).

IN a survey of oil-refining and reserve capacities of the United States and other petroleum-producing nations, it is pointed out that during the first six months of 1951, motor-vehicle gasoline output reached an annual rate of approximately 1 billion bbl. This compares with 600 million bbl in 1939, an increase of about 73 per cent.

Civilian gasoline demands absorb the available supply, and some may draw the conclusion that there is no greater margin today to meet increased requirements than there was in 1939. This is not the case, however, as it is far easier to meet military needs by diverting the necessary gasoline from a large daily output than it is from a much smaller one.

More than 6 million bbl of refined petroleum products are delivered daily in the United States, and oil companies are expanding their production as fast as possible to meet not only the increasing civilian demand but also the eventuality of all-out war.

Accurate figures on the military demands of an all-out war cannot be supplied. The nature of such a war will be the determining factor. The outbreak of a war tomorrow would produce different effects from a similar occurrence sometime in the future.

The location and the number of theaters of operations, the composition of the air forces (jets as opposed to piston engines), are factors concerning which there is no certain knowledge.

The outstanding fact is that the United States, if forced to fight another war, would need petroleum products far in excess of World War II needs.

Discussing world-supply sources, the paper states that European production outside the Iron Curtain is negligible, leaving Europe to depend on imports from the rest of the world. Venezuela and the Middle East are the principal European sources, and recent shutdown of Iran's Abadan refineries has curtailed about one third of the Middle East output.

Loss of Iranian production is serious but not catastrophic, but a spread of the difficulty in Iran to other Middle East countries could have serious repercussions.

At present some Venezuelan production is being diverted to Europe to supplant the lost Iranian supply. Meantime ECA money has helped Europe build up its refining capacity so that by the end of 1952 Europe should have enough refineries to meet its needs—provided adequate crude oil is available.

The United States has a large stake in this European refining capacity, having paid for much of it as taxpayers. If Middle East crude is available, demands on Western Hemisphere crude supplies will be lessened. Furthermore, if Euro-

pean countries can purchase crude oil rather than refined petroleum products and do their own refining, the demands on their dollar resources are reduced.

Strategically, the United States must consider oil reserves—i.e., untapped reservoirs—outside the Western Hemisphere's limits.

The importance of Iran, Saudi Arabia, Kuwait, and Iraq, whose proved reserves constitute 46.6 per cent of the estimated world reserves, is obvious when contrasted with 29 per cent for the United States.

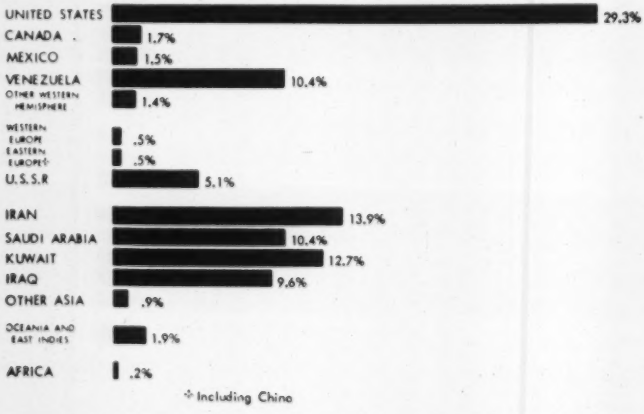
In event of all-out war, the major problem would be transportation, enough tankers, railway cars, and pipe lines to move petroleum to both military and civilian consumers.

Tankers would be diverted to supply Europe should the Suez Canal be closed. Local shortages of petroleum products in the Northeast may occur should this diversion be necessary. The government might even find it necessary in an all-out war to reconvert the Big and Little Inch lines from natural gas back to petroleum, although this is not likely.

Many users of heating oils and natural gas in the Northeast would be forced to use coal under such conditions. We are now sending coal to Europe so this, too, poses new problems. The coal docks at Norfolk have never coped with this dual demand.

Fortunately, the non-Iron-Curtain nations have most of the world's tankers and we have at least more flexibility in meeting shifting petroleum-supply situations than do our potential enemies.

The pipe-line network in the United States transports tremendous quantities of crude and refined products. Two dozen major oil and natural-gas pipe lines are now under construction. We will be in a much better position to meet increasing mobilization demands when they are completed.



DISTRIBUTION OF WORLD'S ESTIMATED PROVED CRUDE RESERVES ON JANUARY 1, 1951

Hydraulics

Runaway Speed of Kaplan Turbines, by Grant H. Voaden, Mem. ASME, S. Morgan Smith Company, York, Pa. 1951 ASME Annual Meeting paper No. 51—A-100 (mimeographed, to be published in Trans. ASME).

The objects of this paper are as follows:

1 To illustrate the type of laboratory test data which a turbine manufacturer must have to predict intelligently the runaway speed of a Kaplan turbine.

2 To point out the significant differences between the "on-cam" and "off-cam" runaway speeds.

3 To present data on actual runaway-speed tests conducted on a large Kaplan turbine installation.

4 To call attention to the possibility of reducing the runaway speed by restricting the minimum angle to which the runner blades can be pitched.

5 In general, to provide information that will aid the purchaser of a Kaplan turbine to decide what runaway speed should be provided for in the generator.

Wood Technology

Economics of Hardboard Manufacture, by Armin Elmendorf and Charles M. Kreider, Elmendorf Research, Inc., Chicago, Ill. 1951 ASME Annual Meeting paper No. 51—A-154 (mimeographed).

FACTORS that enter into the cost of manufacturing hardboard are analyzed and it is shown that both the fixed charges and the conversion cost exceed the cost of materials. Freight costs from several possible factory locations to the major U. S. market emphasize the advantage of manufacture in the East even though the raw materials are in far greater supply in the Northwest. The cost of manufacturing a wood-particle board by the dry resin process is compared with the cost of wood-fiber hardboard made by the wet process.

The term "hardboard" as used in this analysis refers to the synthetic board having a density of about 0.9 to 1.2, made of wood fibers, by any one of several processes, having a modulus of rupture o 5000 to 6000 psi, and a modulus of elasticity of 500,000 to 600,000 psi. The thickness of commercial hardboards generally ranges from $\frac{1}{8}$ to $\frac{1}{4}$ in. and the size from 4 × 8 ft to 4 × 16 ft. Neither the semihardboards having a density below 0.9 are included nor are the boards treated by a tempering process to further improve their properties.

The production of the largest manufacturer of hardboard in the United States is over 20 times that of any of the other manufacturers, of which there are now about a dozen, including those in Canada. This cost analysis is based upon limited data now available from small operations of the latter type. Such an operation may turn out 50 tons or about 100,000 sq ft of board per day in the $\frac{3}{16}$-in. thickness, or the equivalent tonnage in other thicknesses.

Safety

The Relationship Between Industrial Fatigue, Accidents, and Production, by J. V. Grimaldi, Assoc. Mem ASME, Association of Casualty and Surety Companies, New York, N. Y. 1951 ASME Annual Meeting paper No. 51—A-103 (mimeographed).

FATIGUE, a major problem for industry, can generally be traced to the employee's attitude. This paper recommends an engineering and educational program which will reduce the strains of industrial work and will have a beneficial effect on the employee's attitude and physical condition.

Manpower is the most expensive single factor in production costs. Yet most industrial plants know relatively little and often do practically nothing about using their personnel efficiently. Industry

should know the significance, with respect to optimum production, of the definite personnel qualities such as physical condition, attitude, and personality; and the variable qualities such as fatigability and susceptibility to depression, emotional upset, and process conditions and materials.

The fatigue encountered in most of modern industry is not that caused by hard physical exertion. It encompasses that condition of weariness that one may experience at one instant and which, through some psychological stimulation or motivation, can quickly change to a feeling of alertness and vitality. We may say that fatigue is partially related to motivation. This possibility requires that industry look to methods for stimulating employees' interest as a means for eliminating the harmful effects of fatigue.

But it should be remembered that the responses of the individual are initiated and limited according to his make-up. He may fatigue easily, be highly excitable, have the correct attitude toward safety, be relatively free of worry, and so on, depending on his composition and organization. Occasionally these characteristics are affected by the industrial environment.

For example, such materials as carbon tetrachloride, methyl chloride, trichlorethylene, and carbon monoxide can cause dullness, confusion, excitement and languor, headache or visual disturbances, plus other effects upon the worker that would be directly responsible for reduced efficiency or accidental injury and which might simulate the results of fatigue Unpleasant working conditions, such as poor lighting and noise, may have a similar effect.

Research on the relationship between fatigue and accidents in industrial plants has shown that the accident rate increases with each successive hour of the morning, reaching a maximum two to three hours after work begins. In the afternoon portion of the day, following noon recess, the accident number and rate follow a curve similar to the morning's. The indicated presence of fatigue in the causation of accidents is emphasized by the fact that the higher accident risk accompanies the deeper decline of working capacity.

Surveys made during the first extensive employment of women in industry showed that women are much more susceptible to fatigue than men.

While it is difficult to detect and measure fatigue and impossible to accurately estimate its effects, its harmful influence demands action from industry. The following recommendations were made:

1 Each employee should be selectively placed at the proper job. This requires that his work assignment match his physical and mental abilities.

2 The job should be engineered so as to produce the maximum efficiency contributable by the employee. Such factors as illumination, ventilation, posture, awkward movements, safety and health hazards, noise and general plant orderliness should be considered.

3 The supervisor should attempt to reduce any possibility of friction between employees or between employees and himself. He should take a friendly interest in the workers in his department and should make them feel important to the organization.

4 Speed-up of production lines should be done only after full consideration has been given to the possible cumulative effects of the increased-activity demand of the speed-up.

5 Work weeks in excess of 48 hours on a six-day week basis should be avoided whenever possible.

6 For monotonous and repetitive work, it is advisable to allow a five-minute rest period in each work-hour. For less intensive work, a 10 or 15-minute rest period in the middle of the first and last halves of each shift should prove beneficial. It is advisable to provide milk, soft drinks, and nutritious sandwiches at these times.

7 It is advisable to rotate shifts infrequently—for example, every two or three months, rather than every week or two.

8 Educational programs should be planned which will teach the rules for good posture, hygiene, nutrition, recreation, and relaxation.

Fatigue, although indefinable as a quantity, may be considered to have a harmful effect on accident and production rates. A partial solution to the fatigue problem can be accomplished through an engineering and educational program that will reduce the strains of industrial work and which will have a beneficial effect upon the employee's attitude and physical condition.

ASME Transactions for March, 1952

THE March, 1952, issue of the Transactions of the ASME, which is the *Journal of Applied Mechanics* (available at $1 per copy to ASME members; $1.50 to nonmembers) contains the following:

TECHNICAL PAPERS

Bending of a Circular Beam Resting on an Elastic Foundation, by Enrico Volterra. (51—A-18)

The Bending of Uniformly Loaded Sectorial Plates With Clamped Edges, by H. D. Conway and M. K. Huang. (51—A-24)

Bending of a Cylindrically Aeolotropic Circular Plate With Eccentric Load, by A. M. Sen Gupta. (51—A-17)

Linear Bending Theory of Isotropic Sandwich Plates by an Order-of-Magnitude Analysis, by George Gerard. (51—A-31)

Approximate Approach for Torsion Problem of a Shaft With a Circumferential Notch, by H. Ōkubo. (51—A-16)

On the Axisymmetric Problem of the Theory of Elasticity for an Infinite Region Containing Two Spherical Cavities, by E. Sternberg and M. A. Sadowsky. (51—A-10)

The Effect of a Rigid Circular Inclusion on the Bending of a Thick Elastic Plate, by R. A. Hirsch. (51—A-12)

Several Approximate Analyses of the Bending of a Rectangular Cantilever Plate by Uniform Normal Pressure, by W. A. Nash. (51—A-28)

Stresses and Deformations of Toroidal Shells of Elliptical Cross Section, by R. A. Clark, T. I. Gilroy, and E. Reissner. (51—A-11)

Torsion of Curved Beams of Rectangular Cross Section, by H. L. Langhaar. (51—A-14)

On the Direction of Fatigue Cracks in Polycrystalline Ingot Iron, by F. A. McClintock. (51—A-9)

Supersonic Flow With Variable Specific Heat, by F. P. Durham. (51—A-13)

A Contribution to the Theory of the Development and Stability of Detonation in Gases, by A. K. Oppenheim. (51—A-23)

The Time Required for Constant-Volume Combustion, by A. S. Campbell. (51—A-15)

Measurement of Recovery Factors and Friction Coefficients for Supersonic Flow of Air in a Tube—Part 1, Apparatus, Data, and Results Based on a Simple One-Dimensional Flow Model, by J. Kaye, J. H. Keenan, K. K. Klingensmith, G. M. Ketchum, and T. Y. Toong. (51—A-29(a))

The Theoretical Analysis of Metal-Forming Problems in Plane Strain, by E. H. Lee. (51—A-8)

The Optimum Problem of the Sandwich Plate, by W. Flügge.

Statistical Design of Fatigue Experiments, by Waloddi Weibull.

An Electrical Method for Determining Journal-Bearing Characteristics, by D. S. Carter. (51—A-27)

DESIGN DATA AND METHODS

The Calculation of Rectangular Bar Helical Springs, by A. M. Wahl.

BRIEF NOTES

Bending of Honeycombs and of Perforated Plates, by G. Horvay.

Bending of Rectangular Beams, by L. H. Donnell.

A Photoelastic Re-Examination of Notched Tension Bars, by M. M. Frocht, R. Guernsey, Jr., and D. Landsberg.

DISCUSSION

On previously published papers by D. F. Gunder and D. R. Friant; H. J. Plass, Jr.; R. E. Roberson; and Enrico Volterra.

BOOK REVIEWS

COMMENTS ON PAPERS

Including Letters From Readers on Miscellaneous Subjects

Statistical Techniques in Time Study

COMMENT BY HARVEY GITTLER[1]

The author of this paper[2] has presented some of the more important reasons why time study is turning from a science to an art. Because, as the author points out, many shop people have been given time-study training, the industrial engineer has tended to simplify his techniques so that the newly trained time-study man can use these techniques. What the industrial engineer has failed to do is to put into practice the idea of proper work distribution. The shopman turned into time-study man usually is qualified to make the stop-watch recordings, including (when properly trained) the ratings. The shopman is not qualified, unless he has been given advanced education of the college level, to make the analysis of the data and the subsequent synthesis to determine the time standard. Proper work distribution would have shopmen taking the time studies and engineers making the analysis. If this should be too costly, then the analysis can be conducted under the guidance of a qualified engineer by other men.

This is not social or industrial snobbery. It is merely an attempt to distribute the work load so each man can do that part for which he is educationally suited. The writer once had a union time-study steward tell him that the only part of a time standard that was not subject to discussion was the time value actually recorded by the observer. In many plants, this is all too true.

If the author carried his discussion further, he probably would agree that not only is analysis, using statistical methods, a technique to be under the supervision of an engineer, but also the synthesis of the time standard. The application of allowances for fatigue, delays, and interferences should not be on a personal selection basis. Industrial-engineering departments, if properly staffed, can determine consistent methods for applying fatigue allowances. Delay and interference allowances can be determined within ranges of accuracy by compiling data and analyzing them according to statistical procedure. Thus the allowances to be added to properly analyzed time values can be developed into a science. The development of the synthesis technique is an engineering job.

A result of this oversimplification of time study is evident in the number of industrially trained people who call themselves time-study "engineers." Once again, as in the 1920's, industrial engineering is being confronted by opportunists or what the economist so correctly calls the "swarming of the incompetents." Thus our profession stands in danger of being exploited by men schooled in all but the technical aspects of time study.

What appears to be lacking is a free exchange, through publication of papers and presentation of papers at professional meetings, of information giving detailed and more technical information. Often, manufacturers develop equations, formulas, and techniques which could be of value to other industrial engineers. This information is not released or presented because it is regarded as a manufacturing secret. If the information is secret, then the technique of determining data should be shared. Only if time-study engineers adopt a more searching scientific attitude can "the gradual atrophy of the spirit of scientific research in the profession"[2] be avoided.

AUTHOR'S CLOSURE

Mr. Gittler's comment is welcome support for the position maintained in the author's paper. The field is wide open for the further development of scientific techniques for time study. Rule-of-thumb and subjective judgments must be replaced by quantitative techniques. Otherwise, as Mr. Gittler suggests, we shall soon be searching for another name for our profession, because "industrial engineer" will be as odious as "efficiency expert."

The commentator's complaint about the lack of free exchange of ideas may be an oblique reference to the fact that the mathematical basis for the table published with the paper was not given. This omission was caused solely by space limitations. The author has prepared a paper deriving the formula used for calculating the m-values for distribution to those interested, and will be glad to send it upon request as long as the supply lasts.

Several people have indicated an interest in developing tables for other values, and presumably are doing so. In each case the author has offered to serve as a clearing house for any information regarding the extension of or limitations on the use of the technique; he is glad to repeat the offer to the larger audience which MECHANICAL ENGINEERING affords.

G. D. WILKINSON.[3]

Faith of an Engineer's Wife

TO THE EDITOR:

Now and then I have time to thumb through your magazine, MECHANICAL ENGINEERING, and though it's a professional one, some of the articles are not over my head and I find them very interesting. However, it was an advertisement that caught my eye in your January, 1952, issue—this one: "$150 for the best paper by an undergraduate on the subject 'Engineering as a General Education.' This is the Charles T. Main Award." I do not meet the qualifications, since I am not an engineering undergraduate; however, I live with one, and I feel that I can write with some authority on this subject. I'd like to offer my two cents' worth.

I'll grant you that there have been times when I wished my husband had had no higher aims than a peanut vender, but now that we're entering into the home stretch I'm saying a prayer of thanks to the powers that be that first, he took advantage of the opportunity of college itself; and second, that he chose the engineering field.

Our future should be secure. As long as there's an America, men will dream.

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[1] Production Engineer, The Marlo Company, Inc., New York, N. Y. Jun. ASME.

[2] "Application of Statistical Techniques in Time Study," by G. D. Wilkinson, MECHANICAL ENGINEERING, vol. 73, November, 1951, pp. 906–909.

[3] New York, N. Y. Mem. ASME.

As long as men dream, they'll need an engineer to convert those dreams into a reality. A future with opportunity is a wonderful thing to be standing in front of. Opportunities are probably in direct proportion to the amount of knowledge you have stashed away; thus, blessed is the mechanical engineer, for he has built his foundation with a varied assortment of knowledge. Of course, securing a skin from an engineered sheep doesn't guarantee a path of roses for as far as you plan to tread—but, one doesn't find just anybody in an engineering school—one finds fellows with a determined will to survive, so to speak.

When I speak of *future* I am giving it the connotation of building a home and educating our children.

A knowledge of engineering will not only be a means of bringing our future into the present—it's a great help to our everyday living. As an embryo engineer my husband has engineered our present home 'til almost every inch is efficiently utilized, which is a blessing since we don't have many square inches to spare.

Not only that, I have quit taking things for granted, and thereby I am developing a deeper appreciation of life. When we first married I just opened a can and thought nothing of it, except perhaps, "Will he eat tuna fish again, I wonder?" Now when I open a can I am conscious of levers, opposing pressures, ball bearings, and all sorts of things. Stating it simply, my horizon has been broadened. I'm glad.

I'm glad, too, that I'm having a chance to learn the answers to questions our little boys may some day ask me. Thus they won't have an opportunity to think to themselves that "Daddy sure did marry a dumb ole guril."

BETTY MONDAY.[4]

[4] Mrs. J. R. Monday, Knoxville, Tenn.

Books Received in Library

ADVANCED ENGINEERING MATHEMATICS. By C. R. Wylie, Jr., McGraw-Hill Book Co., Inc., New York, N. Y., 1951. Cloth, $6^1/_2 \times 9^1/_2$ in., 640 pp., charts, diagrams, tables, $7.50. This comprehensive work covers ordinary and partial differential equations, Fourier series, and the Fourier integral, operational calculus developed through the use of the Laplace transform, Bessel functions, theory of functions of a complex variable, vector analysis, and such techniques of advanced numerical computation as the numerical solution of equations and systems of equations, finite differences, harmonic analysis, least squares, and the method of Stodola. Applications are illustrated in the fields of mechanical and electrical circuits, vibration, and fluid flow.

BOILER FEED WATER TREATMENT. By F. J. Matthews. Chemical Publishing Co., Inc., New York, N. Y., third edition, 1951. Cloth, $5^1/_2 \times 8^3/_4$ in., 207 pp., charts, diagrams, illus., $4.50. This work is divided into sections dealing with the principal operating problems: scale formation, corrosion, foaming and priming, analysis and routine testing. The object is to present in collected form information of value to the small "ordinary" plant operator who must handle his own problems.

CORROSION. CAUSES AND PREVENTION. By Frank N. Speller. Third edition, McGraw-Hill Book Co., Inc., New York, 1951. Cloth, $6^1/_2 \times 9^1/_2$ in., 686 pp., charts, illus., tables, $10. Extensive revision and additions have been made in this edition which endeavors to give a comprehensive view of the subject. Technical detail has been restricted to that necessary for a sound understanding of the many factors involved in corrosion and the principles of corrosion prevention, mainly with relation to ferrous metals. Many references are included as footnotes but the general bibliography has been omitted from this edition.

FINITE DEFORMATION OF AN ELASTIC SOLID. By Francis D. Murnaghan. John Wiley and Sons, Inc., New York, N. Y., 1951. Cloth, $6 \times 9^1/_4$ in., 140 pp., cloth. $4. The essential feature of this book is the consideration of squares and higher powers of the strain components in the theory of elasticity. This treatment permits the application of the theory to larger deformations and stresses than those allowed by the classical theory. Matrixes are used methodically with a preliminary explanation in the first chapter. Topics of special interest are the importance of nonisotropic media and the problem of deformation under extreme pressures.

FUNDAMENTALS OF AUTOMATIC CONTROL. By G. H. Farrington. John Wiley and Sons, Inc., New York, N. Y., 1951. Cloth, $5^1/_2 \times 8^3/_4$ in., 285 pp., charts, diagrams, tables. $5. A general survey of a wide field, dealing with the underlying principles which affect automatic-control performance rather than with the specific details of plant or apparatus. A thorough mathematical analysis is provided, and the formulation and use of analogies is considered. The final chapter deals briefly with the selection and adjustment of control systems.

GENERATING STATIONS. Economic Elements of Electrical Design. By Alfred Lovell. McGraw-Hill Book Co., Inc., New York, N. Y., fourth edition, 1951. Cloth, $6^1/_4 \times 9^1/_4$ in., 431 pp., charts, diagrams, illus., tables, $6.50. The application of economic principles to the problems of the design of generating stations and transmission systems is described. The selection and application of apparatus, the proportioning of details of the assembly, the balancing of initial and subsequent costs, and related topics are considered. The revised edition presents new material on the gas turbine and advanced designs in circuit breakers and relays and in generating-station auxiliaries. The intention is to give a solid basis for an understanding of the engineering features of the power industry as a whole.

Library Services

ENGINEERING Societies Library books may be borrowed by mail by ASME Members for a small handling charge. The Library also prepares bibliographies, maintains search and photostat services, and can provide microfilm copies of any items in its collection. Address inquiries to Ralph H. Phelps, Director, Engineering Societies Library, 29 West 39th St., New York 18, N. Y.

THE GRINDING WHEEL. By Kenneth B. Lewis. Under the auspices of the Grinding Wheel Institute, Greendale, Mass., 1951. Cloth, $6 \times 9^1/_4$ in., 409 pp., charts, diagrams, illus., tables, $3.50. Beginning with descriptions of abrasive materials, of the making of a grinding wheel, and of the kinds and sizes of wheels, this manual proceeds with a detailed treatment of the various grinding processes, wheel dressing and balancing, tool and cutter sharpening, and factors affecting wheel selection are covered. Honing, lapping, and superfinishing, the grinding of nonmetallics, and other special applications are also discussed.

HEATING DESIGN AND PRACTICE. By Robert Henderson Emerick. McGraw-Hill Book Company, Inc., New York, N. Y.; Toronto, Canada; London, England, 1951. Cloth, $6^1/_4 \times 9^1/_4$ in., 453 pp., illus., charts, tables, diagrams, $8. A practical treatment of methods for the design and operation of steam, hot water, and warm-air heating systems, illustrated with everyday problems from actual working cases. The book covers radiant heating and baseboard units, the heat pump, space heaters, fireplaces, fans, and filters. A section is included on fuels and combustion. The final chapter outlines the preparation of specifications and the making of bid analyses.

HIGH PRESSURE MERCURY VAPOUR DISCHARGE. (Selected Topics in Modern Physics, II.) By W. Elenbaas. North-Holland Publishing Company, Amsterdam, Netherlands, 1951. Cloth, 6×9 in., 173 pp., charts, tables, diagrams, illus. Available in U. S. from Interscience Publishers, Inc., New York, N. Y., $4. A general survey of the theory of the high-pressure mercury-vapor discharge as it now stands after some 20 years of development concurrent with the development of light sources utilizing these discharges. The detailed treatment provides a thorough mathematical analysis of the electronic, thermodynamic, radiational, and spectrographic aspects. There is a considerable list of references.

INSPECTION AND GAGING. By C. W. Kennedy. Industrial Press, New York, N. Y., 1951. Cloth, $6^1/_4 \times 9^1/_4$ in., 302 pp., charts, diagrams, tables, illus., $7.50. This comprehensive training manual and reference work discusses the place of inspection in industry, describes the types of automatic and manual gaging and measuring devices employed, shows the proper techniques of using inspection equipment, and outlines the specific duties of inspection personnel. The detailed descriptions and instructions are illustrated by numerous photographs and line sketches.

THE INSTRUMENTATION OF OPEN-HEARTH FURNACES. (The British Iron and Steel Research Association.) George Allen and Un-

win, Ltd., London, England, 1951. Cloth, $5^1/_2 \times 8^3/_4$ in., 159 pp., charts, diagrams, illus., tables, 30s. Part 1 discusses the function and basic principles of instruments, outlines a recommended level of instrumentation, and suggests how instruments can be utilized to determine optimum working conditions and maintain effective and economic operation over a prolonged period of time. Panel layouts and automatic control systems are included. Part 2 provides brief descriptions of the construction details and operation of the instruments most commonly used in British open-hearth furnace melting shops.

INVENTIONS AND THEIR MANAGEMENT. By Alf K. Berle and L. Sprague De Camp. International Textbook Company, Scranton, Pa. Third edition, 1951. Cloth, $5^1/_2 \times 8^1/_2$ in., 742 pp., diagrams, illus., $7.50. This comprehensive, standard work presents the principles and practices governing the technical, legal, and business procedures of invention, from the history and theory of the protection of ideas to the methods of exploitation. Numerous illustrative cases from actual experience are given. Foreign patents, trademarks, and copyrights are discussed, patent drafting is briefly considered, and a glossary and detailed index are included.

ISOTHERMAL TRANSFORMATION DIAGRAMS FOR NICKEL STEELS. Published by The Mond Nickel Company, Ltd., London, England, 1951. Cloth, $6^1/_2 \times 9^3/_4$ in., 57 pp., charts, diagrams, illus., tables. The construction, general features, and limitations of isothermal transformation diagrams are explained in the preliminary text matter. The effect of various elements on the transformation, the influence of structure on mechanical properties, and special heat-treatments based on these diagrams are also discussed. Facing each of the 13 diagrams is a page of tabular data concerning the particular nickel steel represented.

MANUFACTURING PROCESSES. By Myron L. Begeman. John Wiley and Sons, Inc., New York, N. Y. Third edition, 1952. Cloth, $6^1/_4 \times 9^1/_4$ in., 608 pp., diagrams, illus., $6. Beginning with foundry practice and ending with grinding wheels and abrasives, this volume presents the technical fundamentals of the important manufacturing processes, discusses engineering materials, and describes the modern machine tools necessary for processing these materials. Inspection and gaging are covered. New material includes continuous casting of metals, hydrodynamic forming, plastic molds, special welding techniques, new jigs and fixtures, and various automatic and semiautomatic production machines.

MATERIALS HANDLING. Principles, Equipment and Methods. By Harry E. Stocker. Prentice-Hall, Inc., New York, N. Y. Second edition, 1951. Cloth, $6^1/_4 \times 9^1/_4$ in., 330 pp., diagrams, illus., tables, $5. The fundamental principles involved in the economical handling of those materials not handled in bulk, and the equipment and methods used are described and explained. A large amount of information about trucks, tractors, conveyers, cranes, and other equipment is provided, with many illustrations. The main revision has occurred in the chapters on conveyers, the selection of equipment, and building design as related to materials handling.

MÉTHODE DES DIFFÉRENCES FINIES APPLIQUÉE AUX PROBLÈMES BIDIMENSIONNELS DE CALCUL DES CONTRAINTES D'UNE PLAQUE. By F. Salles et C. Thom. France, Ministère de l'Air, Publications Scientifiques et Techniques. No. B.S.T. 115, 1951. Paper, 7 × 10 in., 84 pp., charts, tables, 450 fr. The first half of this publication reviews briefly certain analytical procedures in connection with the theory of plate stresses and explains the method of mathematical analysis known as the "method of finite differences." In the second half the application of this method of finite differences to stressed-plate analysis is demonstrated with practical examples.

THE NON-DESTRUCTIVE TESTING OF METALS. By R. F. Hanstock. The Institute of Metals (Monograph and Report, series no. 10), 4 Grosvenor Gardens, London, S.W.1, England, 1951. Cloth, $5^1/_2 \times 8^1/_4$ in., 163 pp., charts, diagrams, illus., tables, $3.50. In this monograph consideration is given not only to the well-known radiographic, magnetic, and ultrasonic methods but also to other available methods of examination with the object of providing a reference work giving alternative approaches to special problems. To this end the limitations are carefully indicated within which a test may be expected to operate successfully. Test classifications dealt with are thickness measurements, surface finish, defect detection, composition analysis, mechanical properties, and physical state.

PAINT AND VARNISH PRODUCTION MANUAL. Edited by Verne C. Bidlack and Edgar W. Fasig. John Wiley and Sons, Inc., New York, N. Y., 1951. Cloth, 6 × $9^1/_2$ in., 288 pp., diagrams, illus., tables, $6.50. Designed for the instruction of production personnel, this book describes the necessary physical facilities of paint and varnish plants. The various products are discussed, and engineering and manufacturing operations are considered with regard to actual practice. The last several chapters deal with personnel, factory cost accounting, research development and control, fire protection, safety, and health.

PROCEEDINGS OF THE THIRD ANNUAL INDUSTRIAL ENGINEERING INSTITUTE. Published by the University of California, Berkeley, Calif., 1951. Paper, $8^1/_2 \times 10^3/_4$ in., 82 pp., charts, diagrams, illus., tables. The seventeen papers included in this publication deal with the following topics: work-factor aspects; methods-time measurement; production estimating; time-study rating; operational studies; personnel handling; and union problems in setting production standards. The presentation of some of the papers was accompanied by the showing of films. These films have been made available for purchase.

REVISED STEAM TABLES AND DIAGRAMS OF THE JAPAN SOCIETY OF MECHANICAL ENGINEERS, 1950. Cloth, $8^1/_2 \times 11^1/_2$ in., 50 pp., charts, tables. These tables, the result of a recent working over of previously publish data, are divided into three groups: saturated steam and water (temperature base); saturated steam and water (pressure base); superheated steam and compresed water. An explanatory introduction precedes the tables, and a large Mollier chart is appended.

STRENGTH OF MATERIALS. By Glen N. Cox, Frank J. Germano, and John H. Bateman. Pitman Publishing Corporation, New York, N. Y.; Toronto, Canada; London, England, 1951. Cloth, $6^1/_4 \times 9^1/_4$ in., 408 pp., diagrams, charts, tables, $5.50. A textbook which emphasizes the topics which the authors have found that students have difficulty in assimilating. It is intended for a first course in strength of materials and covers the structural elements, stress conditions, and analytical methods commonly included in such texts. Tables of elements of structural sections are appended and over 500 problems of graded difficulty accompany the text.

TECHNOLOGY OF THE MACHINE SHOP. By H. C. Town. Longmans, Green and Co., New York, N. Y. Cloth, $5^1/_4 \times 8^1/_4$ in., 366 pp., diagrams, illus., $4. Both the scientific and production aspects of the metal-cutting processes are covered in this text. Basic principles of machine-tool types are presented, and the latest practice in mechanical, electrical, and hydraulic operation is described. Diamond tools, cemented carbides, and precision-finishing tools are dealt with, as well as the comparatively new subject of automatic sizing and measurement during machining.

THEORY OF VIBRATIONS. By N. W. McLachlan. Dover Publications, Inc., New York, N. Y., 1951. Cloth, $5^1/_4 \times 7^3/_4$ in., 154 pp., charts, diagrams, $2.95. Based on a series of graduate-course lectures, this small text provides concise coverage of linear and nonlinear systems having one or more than one degree of freedom and of the vibration of strings, bars, tubes, annular membranes, and circular plates. The last chapter deals with sound waves of finite amplitude. The use of frequency spectra and the application of certain mathematical techniques are special features.

THERMODYNAMICS. By Alfred W. Porter. (Methuen's Monographs on Physical Subjects.) Fourth edition. John Wiley and Sons, Inc., New York, N. Y., 1951. Cloth, $4^1/_4 \times 6^3/_4$ in., 124 pp., diagrams, $1.50. The opening chapter of this small book gives a historical account of the laws and other basic aspects of thermodynamics. The remaining four chapters present the text material under the following headings: reversible changes; miscellaneous applications; irreversible operations; on equilibrium.

TOP-MANAGEMENT ORGANIZATION AND CONTROL. By Paul E. Holden and others. Published for the Stanford University Graduate School of Business by McGraw-Hill Book Co., Inc., New York, N. Y., 1951. Cloth, $6^1/_4 \times 9^1/_4$ in., 257 pp., charts, $5. In this research study of management policies, and practices, the material has been drawn from the investigation of thirty-one leading industrial concerns operating in several of the major industrial fields. The study, as indicated, is restricted to top-management problems, and simply records what seem to be the most effective and generally applicable plans and devices found. The detailed information presented was gained through field interviews and a copy of the data sheet used is appended.

WORLD RAILWAYS. 1950–1951. Edited and compiled by Henry Sampson. Rand McNally and Company, Chicago, Ill., 1951. Cloth, $8^1/_2 \times 13$ in., various pagings, charts, diagrams, illus., tables, $25. Intended as a companion volume to reference works such as Jane's "Fighting Ships" and Jane's "All the World's Aircraft," it includes route mileage, number of locomotives and cars, train control and signaling devices, illustrations and abridged specifications of locomotives and cars, and other information, arranged by country.

YEARBOOK OF THE HEATING AND VENTILATING INDUSTRY, 1951. Issued in collaboration with the Association of Heating, Ventilating, and Domestic Engineering Employers by Technitrade Journals, London, England, 1951. Cloth, $5^1/_2 \times 8^1/_2$ in., 284 pp., illus., charts, tables, 7s, 6d. The current edition of this annual publication offers a half-dozen technical articles in the field, a thirty-three page bibliography of articles published during 1950, a buyers' guide to British suppliers of heating and ventilating equipment, a list of British trade names, and other miscellaneous information connected with the industry

ASME NEWS

With Notes on the Engineering Profession

Cincinnati Section to Be Host to ASME During the 1952 Semi-Annual Meeting

Headquarters at Sheraton-Gibson Hotel, June 15–19, 1952

THE 1952 Semi-Annual Meeting of The American Society of Mechanical Engineers will be held at the Sheraton-Gibson Hotel, Cincinnati, Ohio, June 15–19, 1952.

The National Nominating Committee of the Society will hold a meeting during the Semi-Annual Meeting and members wishing to speak in support of any proposed nominee have the privilege of appearing before the Committee. Also during the Semi-Annual Meeting, there will be a Business Meeting.

The Technical Program

There are 42 technical sessions, luncheons, and dinners scheduled for this meeting. Several inspection trips are planned to include many industrial plants for which Cincinnati is famous. The following Professional Divisions and Committees are sponsoring sessions, Aviation, Fuels, Gas Turbine Power, Heat Transfer, Hydraulic, Industrial Instruments and Regulators, Machine Design, Management, Materials Handling, Metals Engineering, Petroleum, Power, Process Industry, Production Engineering, Railroad, Engineers Civic Responsibility, Junior, Effect of Temperature, and Education.

Cincinnati—Queen of the Midwest

Cincinnati, the 18th largest city in the United States, is a commercial and industrial center, a river port and port of entry (41st Customs District). In 1947 it ranked 14th among metropolitan areas of the U. S. It is served by the major airlines and railroads and has one of the nations's finest railway terminals. The city is beautifully situated in half of a circular amphitheater of hills on the Ohio River. Cincinnati has long been a printing and publishing center. The famous "Eclectic Readers" of William Holmes McGuffey were first published by a Cincinnati firm in 1830.

The many fine educational institutions in the city have developed progressive programs. The idea of the co-operative system of technical education originated at the University of Cincinnati. The Ohio Mechanics Institute, founded in 1829, gives courses in mechanical trades and arts, and houses an industrial museum.

The Cincinnati Art Museum houses an excellent and varied collection of art which includes a complete Louis XIV salon, the U. S. Playing Card Company's comprehensive historical collection of playing cards, and the noted collection of Meissen porcelain, and the Museum Library covers every period in art.

Another point of interest is the recently completed Walter C. Beckjord generating station, which went into operation April, 1952.

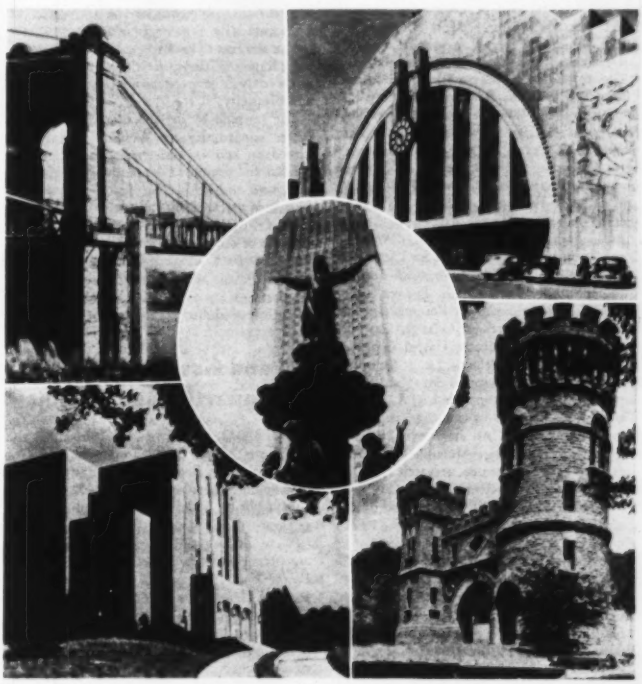
Calvin W. Rice Lecture

The Calvin W. Rice Lecture will be given at a luncheon to be held on June 18 and the lecturer will be Dr. Ing. Piero Ferrerio, chairman and president of the Edison Company, Milan, Italy. He will be introduced by W. L. Cisler, Fellow ASME, president, The Detroit Edison Company. R. J. S. Pigott, president, ASME, will preside at the luncheon.

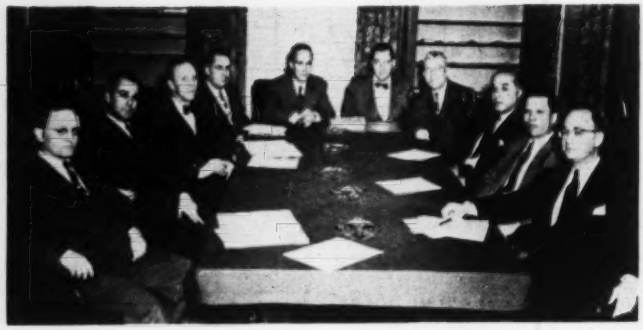
The Roy V. Wright lecturer will be the Hon. W. C. Foster, Deputy Secretary of Defense, Washington, D. C. The president's luncheon, at which Mr. Pigott will speak, is scheduled for Monday, June 16; other luncheons and a banquet are planned. The closing luncheon will be given by the Management and Product Engineering Divisions.

Committee

The following committee is in charge of arrangements: *General Chairman*, G. H. Larkin; *Co-Chairman*, D. S. Brown, *Secretary*, R. F. Schierland. The chairmen of the various subcommittees are as follows: *Finance*, E. H. Mitsch; *Hotel*, R. H. Howorth; *Technical Events*, M. E. Martellotti; *Reception*, E. H. Schubert; *Entertainment*, J. G. Martin; *Plant Trips*, H. B. Welge; *Ladies Activities*, F. J. Simonitsch; *co-chairman*, Mrs. F. J. Simonitsch; *Signs*, I. J. Rand; *Information, Registration, and Service*, E. J. Martin; *Publicity*, A. L. Kiewit.



POINTS OF INTEREST IN CINCINNATI, OHIO, SCENE OF 1952 ASME SEMI-ANNUAL MEETING
(*Upper left*, Suspension Bridge; *upper right*, Union Terminal; *center*, Tyler Davidson Fountain; *lower left*, Wilson Auditorium, University of Cincinnati; *lower right*, Main entrance, Eden Park.)



1952 ASME SEMI-ANNUAL MEETING EXECUTIVE COMMITTEE

(*Left to right:* A. L. Kiewit, E. A. Emmer, R. F. Schierland, F. J. Simonitsch, G. H. Larkin, C. F. Hardy, E. H. Mitsch, M. E. Martellotti, R. W. Howorth, I. J. Rand. Not shown are: D. S. Brown, E. H. Schubert, and J. G. Martin.)

ASME Region VIII to Hold Third Annual Meeting in Denver, Colo., April 28–30, 1952

THE third annual meeting of ASME Region VIII will be held at the Albany Hotel, Denver, Colo., April 28–30. The Rocky Mountain Tier, Region VIII, Student Conference will be held at the same time.

The following papers will be presented: "Industry's Role in Training Engineers for Tomorrow," by H. R. Pearson, head, personnel department, Dallas Power and Light Company, Dallas, Texas. "Oil Fog Lubrication," by D. G. Faust, chief engineer, C. A. Norgren Company, Englewood, Colo. "The Production of Sugar From Beets," by F. M. Sakine, general superintendent, American Crystal Sugar Company, Denver, Colo. "Welding Controls, Inspections, and Tests for Large Steel Pipes," by P. J. Bier, head, Penstock Section, U. S. Bureau of Reclamation, Denver, Colo. "Some Considerations in the Construction and Operation of High-Pressure Offshore Gas Pipe Lines," by M. P. Watson, United Gas Pipe Line Company, New Orleans, La. "Deionization, Its Practical Aspects for Hard-Water Supplies," by T. C. Hoppe and R. A. Russell, Black and Veatch, consulting engineers, Kansas City, Mo. "An Improved Schlieren Apparatus Employing Multiple-Slit Gratings," by T. A. Mortensen, research engineer, Midwest Research Institute, Kansas City, Mo.

In addition, papers will be presented by one student from each of the schools in the Rocky Mountain Tier, Region VIII.

The annual banquet will be held April 28. Awards for the outstanding student papers will be made at a joint member-student luncheon, April 29.

Inspection trips are planned to the Gates Rubber Company, the Reclamation Engineering Center and Testing Laboratory of the U. S. Bureau of Reclamation, and a visit to the Denver Mountain Parks. A special program is planned for the ladies.

ASME Applied Mechanics Division Schedules West Coast Conference

THE West Coast committee of the Applied Mechanics Division of The American Society of Mechanical Engineers will hold its West Coast Conference at the University of California, Los Angeles, June 26–27, 1952.

The subjects to be discussed are: Dynamics, including vibrations, elasticity, experimental stress analysis, strength properties of materials, and plasticity.

The purpose of the meeting is to provide better opportunity for Western engineers to attend an annual conference on applied mechanics and to present the results of original research in the field. The first Western Conference of the Applied Mechanics Division was held at Stanford University last summer. Because of the interest shown at this meeting the Western Conference was adopted as an annual affair. Membership in ASME is not a requirement for participation in the meeting as author or auditor.

Oil and Gas Power Division Conference and Exhibit

BUFFALO, N. Y., has been chosen as the scene of the 24th annual Oil and Gas Power Division Conference and Exhibit to be held at the Statler Hotel, June 23–27, 1952.

In addition to the exhibit and technical sessions—theme of the technical sessions being "Phases of Engine Design"—inspection trips are planned to the Schoellkopf Hydroelectric Power Plant. Supper at the General Brock Hotel will follow a trip to Niagara Falls on Tuesday evening. The banquet will be held on Wednesday. On Thursday a trip to the Worthington Pump and Machinery Corporation is scheduled. An all-day trip to Clark Brothers Company, Inc., and Van der Horst Corporation, both situated in Olean, N. Y., is on the program for Friday.

An afternoon panel discussion on "Design in General" is to be held on June 25 and included among the speakers will be R. J. S. Pigott, president, ASME, who will discuss, "Lubrication—Service and Materials."

The General Technical Committee meeting will be held Monday evening, June 23, 1952.

EIC Annual Meeting to Be Held in Vancouver, B. C.

MEMBERS of ASME are cordially invited to attend the 66th annual meeting of The Engineering Institute of Canada to be held at Vancouver, B. C., May 7–9, 1952. A comprehensive technical program has been arranged consisting of 24 papers covering a wide range of subjects. Special speakers have been invited for the luncheons and banquet. In addition, there will be tours, plant visits, side trips, and a boat trip around Vancouver Harbor.

For full particulars of program and reservations write to the General Secretary, The Engineering Institute of Canada, 2050 Mansfield Street, Montreal 2, Que., Can.

Time-Study Research Theme of SAM-ASME Conference

PRACTICAL methods, improved techniques, and the latest research in the field of time study will be the theme of the seventh annual Time-Study and Methods Conference to be sponsored by the Society for the Advancement of Management, Inc., and the Management Division of The American Society of Mechanical Engineers.

SAM and ASME have invited more than 35,000 men in management to attend this conference which will be held at the Hotel Statler, New York, N. Y., April 24–25, 1952.

Concurrent sessions will take place both days with 16 outstanding management men covering all levels and areas of management. The program is an integrated one. The first part is built upon the application of methods and techniques and the second part reports the latest important research in the field of time study and methods study.

The registration fee for the full conference, including two luncheons and dinner, will be $24 for SAM and ASME members, and $32 to nonmembers.

The program follows:

THURSDAY, APRIL 24

Morning

The Application of Time Study and Methods to Cost Control, by *J. E. Newsome,* superintendent of Johnson and Johnson, Chicago, Ill.

Pricing and Unit Cost and the Application of Time Study and Methods, by *D. H. Dalbeck,* treasurer and controller, Reed-Prentice Corporation, Worcester, Mass.

The Application of Time Study and Methods to Sales and Distribution, by *Nobel Hall,* manager of the Sales-Research Division, The Atlantic Refining Company, Philadelphia, Pa.

Luncheon Session

Speaker: *W. H. Wheeler, Jr.,* president, Pitney-Bowes, Inc., Stamford, Conn.

Subject: **How Time-Study and Methods Techniques Help Members of Top Management Fulfill Their Responsibilities to Their Customers**

Afternoon

Planning, Scheduling, Inventory, by *S. L. Palmert*, chief industrial engineer, Whirlpool Corporation, St. Joseph, Mich.

The Application of Time Study and Methods to Tools, Equipment, and Layout, by *D. F. Capell*, vice-president, engineering and personnel training, Wagner Baking Corporation, Newark, N. J.

Office and Clerical Work, by *B. S. Graham*, chairman of the Future Demands Committee, Standard Register Company, Dayton, Ohio

Dinner Session

Speaker: *H. W. Steinkraus*, chairman and president, Bridgeport Brass Company, Bridgeport, Conn.

Subject: **How Time-Study and Methods Techniques Help Members of Top Management Fulfill Their Responsibilities to Their Workers**

FRIDAY, APRIL 25

Morning

Maintenance and the Application of Time Study and Methods, by *H. A. Bogle*, supervisor of management engineering, Consulting Section, E. I. du Pont de Nemours and Company, Wilmington, Del.

Inspection and the Application of Time Study and Methods to It, by *W. R. Overby*, motion-time analysis supervisor, Carter Carburetor Company, St. Louis, Mo.

The Application of Time Study and Methods to Materials Handling, by *C. J. Crowley*, Manager, materials-handling department, The Singer Manufacturing Company, Elizabeth, N. J.

Luncheon Session

Speaker: *Henderson Supplee, Jr.*, executive vice-president, The Atlantic Refining Company, Philadelphia, Pa.

Subject: **How Time-Study and Methods Techniques Help Members of Top Management Fulfill Their Responsibilities to Their Stockholders**

Afternoon

Ration Delay Developments, by *C. L. Brisley*, industrial engineering manager, Wolvering Tube Division, Calumet and Hecla Consolidated Copper Company, Detroit, Mich.

Research Report on Machine Interference, by *K. O. William Sandberg*, manager, industrial-engineering department, Chemical Division, General Electric Company, Pittsfield, Mass.

MTM Analysis of Performance Rating Procedures, by *A. M. Lang*, executive secretary, MTM Association for Standards and Research, Pittsburgh, Pa.

D. B. Porter, Mem. ASME, professor of industrial engineering, New York University, will present "Recent Research on SAM Rating" films. The films will be shown in full after each of the four sessions.

AMA Opens Management Training Center

THE American Management Association formerly opened its new management training center in New York, N. Y., Feb. 4, 1952, in quarters at the Hotel Astor. A capacity registration of 135 executives from leading industries, representing the upper levels of management, were enrolled in the initial course unit of the six-unit management training program.

L. A. Appley, Assoc. ASME, president of AMA, described the new center and curriculum as initiating a new approach to management education. He said it answers a demand in industry for integrated training in the higher skills of management.

In addition to Mr. Appley, among those working with the first group of registrants in the initial phases of the course, are K. S. McHugh, president, New York Telephone Company; C. H. Gager, vice-president, General Foods Corporation; J. M. Hancock, partner, Lehman Brothers; A. L. Nickerson, vice-president, Socony-Vacuum Oil Company; and J. D. Gray, president, Wallachs, Inc. W. H. Kushnick, Mem. ASME, is in charge of the training program.

The AMA training center is not intended for the beginner in the field of management. Course material has been developed in response to the demands of major companies for an extended educational program designed to help develop executives for the assumption of greater responsibility and authority.

The over-all plan will enable small groups of executives to meet for weekly periods to receive the guidance of discussion leaders selected by AMA from the ranks of top management. The schedule has been arranged in units of one week each and may be taken in immediate succession or over a period of time.

AMERICAN COAL-SAVING DEVICES ADAPTABLE TO BRITISH INDUSTRY ARE STUDIED BY THIS BRITISH GROUP OF FUELS EXPERTS DURING VISIT TO BATTELLE MEMORIAL INSTITUTE, COLUMBUS, OHIO

[Center of their interest is the electric-eye control on an over-fire jet system. The British team's visit at Battelle was part of a six-week tour of American industrial plants and research centers. The tour is being sponsored by the Mutual Security Agency and the Anglo-American Council on Production. Members of the group are (*left to right*): F. G. Ritchie, director of engineering laboratories, B.C.U.R.A., Leatherhead; W. J. Dickie, technical officer, Federation of British Industries, London; Leonard Boon, director, Powell Duffryn Technical Services, Ltd., London; W. S. Hudson, principal scientific officer, Department of Scientific and Industrial Research, Washington, D. C.; John Hall, chief engineer, I.N.D. Coope and Allsop Ltd., London; F. W. Thomas, head of finishing department, B.C.I.R.A., Shirley Institute, Manchester; L. C. Watts, sole partner, J. Royer Preston & Partners, London; H. E. Partridge, Mem. ASME, founder and precedent partner, Partridge, Earp, and Partners, Edinburgh; J. H. Harris, deputy manager, power department, I.C.I., Ltd., Liverpool; W. A. Wordley, chief power-plant engineer, Bradford Dyers' Association, Ltd., Bradford, V. A. DeYoung, M.S.A. project manager; R. H. Brennan, fuel-efficiency engineer, Albert E. Reed and Company, Maidstone, Kent; J. W. Wray, divisional chief engineer, International Combustion, Ltd., Derby; and H. E. Hyatt, chief cost accountant, William Hollins and Company, Ltd., Nottingham.]

Summer Management Course at State University of Iowa

THE college of engineering, State University of Iowa, announces the 13th summer management course to be held June 9-21, 1952, in Iowa City.

Since its inception, nearly 900 representatives of American and foreign industries have increased their understanding of the design and application of management techniques.

The areas of production planning, job evaluation, motion and time study, wage incentives, plant layout, quality control, supervisory training, labor relations and legislation, organization and policy, and public speaking are included.

Communications concerning the course should be sent to Wayne Deegan, 113 Engineering Building, State University of Iowa, Iowa City, Iowa.

Kettering at Purdue

INDIANA Engineering Exposition which will be held in the Purdue University Armory Lafayette, Ind., May 2-4, 1952, is sponsored by the Indiana Engineering Council for the purpose of showing students and the public the opportunities of a career in engineering. The Exposition will tie in the role of an engineering education with the part engineers play in industry in general.

The high light of this event will be an address by C. F. Kettering, Fellow ASME, of General Motors Corporation, at the Purdue Music Hall, in the afternoon, May 3.

The Engineering Manpower Commission will participate in the Exposition.

ASME Applied Mechanics Conference to Feature Shock and Vibration Instrumentation Symposium

The Pennsylvania State College, June 19–21, 1952

THE Applied Mechanics Division of The American Society of Mechanical Engineers announced recently that plans are rapidly developing for a shock and vibration instrumentation symposium to be held during its summer conference at The Pennsylvania State College, State College, Pa., June 19–21, 1952.

Although the principles of operation, sources of error, and methods of calibration of instruments will be stressed, a well-rounded program will be presented covering all fields of interest relating to current shock and vibration testing.

Symposium Program

The program for the symposium includes papers in the following categories: Survey and historical, one-degree-of-freedom instruments, sources of error and secondary effects, peak-reading gages, calibration, and applications. The symposium will close with a general discussion intended to bring out the difficult and intriguing problems which are in urgent need of solution in the instrumentation field and thus to stimulate further development.

Papers to Be Published

It is expected that the symposium papers and discussion will be published in a single volume which will present the current state of knowledge on shock and vibration instrumentation.

Scheduled as one of the speakers is C. C. Furnas, Mem. ASME, director, Cornell Aeronautical Laboratory, Inc., Buffalo, N. Y. The subject of his talk will be "Future Trends in Aviation."

Important Notice to ASME Members

IF YOU are planning to attend the Centennial of Engineering to be held in Chicago, Ill., Sept. 3-13, 1952, during which time the ASME Fall Meeting will be held, Sept. 8–11, make your hotel reservations *without delay*. The Hotel Sheraton will be ASME headquarters.

Centennial of Engineering to Have World-Wide Scope

Seven Foreign Nations to Participate

FIRST indication of the world-wide scope of the Centennial of Engineering to be celebrated in Chicago, Ill., Sept. 3-13, 1952, was given in an announcement that the leading scientific societies of seven foreign nations have pledged active participation. These are in addition to the American scientific and engineering bodies, including The American Society of Mechanical Engineers, whose 1952 Fall Meeting will be held in Chicago, Sept. 8–11, at the Sheraton Hotel.

In each case the foreign organizations have agreed to send sizable delegations of their best-known figures to this country for the 10-day convocation, the public exhibit of world engineering progress in the past 100 years, and the stage presentation to be included in the Centennial program.

Foreign Delegations

One of the largest foreign delegations will be that of the Royal Society of Industrial Engineers of Belgium, which will send 11 delegates. Other bodies to be represented include the Japanese Society of Civil Engineers, The Institution of Civil Engineers of Great Britain, The Institution of Mechanical Engineers of Great Britan, the World Power Conference which has its headquarters in London with branches in France and India, the College of Civil Engineers of Mexico, The Engineering Institute of Canada, and the Association of Professional Engineers of the Province of Ontario.

Other prominent engineering bodies in Norway and France are definitely pledged to participate although they have not yet indicated the exact make-up of their delegations.

European engineering societies, as well as those of Latin and Central America, will have leading parts in the ceremonies planned for the International Day program, scheduled to open the convocation meeting on September 3.

Centennial Stage Presentation

Helen T. Geraghty, nationally known producer, was selected to direct the stage presentation planned as one of the features of the Centennial of Engineering.

Mrs. Geraghty has been the key figure in several public spectacles that have drawn collective audiences almost unrivaled in the history of the American stage. She was one of the producers of "Wings of a Century," "Wheels A'Rolling," and "Frontiers of Freedom."

In her latest project Mrs. Geraghty will produce a dramatic portrayal of the outstanding contributions the engineering profession has made to the American way of life. As background, certain fast-moving scenes will depict the greatest moments in man's technical progress all the way from the days of the caveman, the building of the Pyramids, the Appian Way, and the Chinese Wall, down to latest developments occasioned by the splitting of the atom.

To Run to Mid-September

While no name has been selected as yet for the Centennial stage show, it is indicated that it will probably open to the public about July 15 and run until mid-September. It will be staged in the 1000-seat theater of the Museum of Science and Industry on Chicago's lake front. Present plans call for two or three shows daily, with a heavier schedule over the weekends.

Convocation Program Features

The convocation in connection with the Centennial of Engineering undoubtedly will bring together the greatest gathering of engineers ever assembled. It is estimated that attendance will total at least 30,000. Major features of the convocation are planned as follows: Symposium programs on subjects selected because of their broad impact on the lives of people and the advancement of civilization, technical, and other functions on the part of individual societies, social events, and local trips to points of interest to engineers, engineering exhibits, and a stage production.

Symposiums

It is intended that symposium papers be presented in sufficiently nontechnical terms to be readily understandable by the average layman while, at the same time, they will be of specific value to engineers. The object is to enhance evaluation of the contributions of engineering to the advancement of civilization on a world-wide pattern—past, present, and future. Each subject will be developed with appreciation of its social and economic aspects and of its dramatic appeal. The following is a listing of symposium subjects with the names of chairmen who have been chosen to direct the programs: Professional societies, H. S. Rogers, Mem. ASME, president, Polytechnic Institute of Brooklyn; education and training, A. A. Potter, Hon. Mem. ASME, dean of engineering, Purdue University; food, Clarence Francis, chairman of the board, General Foods Corporation, New York, N. Y.; tools, K. H. Condit, Mem. ASME, dean, school of engineering, Princeton University; structures and construction, W. G. Bowman, editor, *Engineering News-Record*; transportation, C. F. Kettering, Fellow ASME, research consultant, General Motors Corporation; mineral industries, C. L. Williams, Mem. ASME, director, Battelle Memorial Institute; chemical industries, selection pending; communications, W. H. Harrison, president, International Telephone and Telegraph Company; energy, Eugene Ayres, technical assistant to executive vice-president, Gulf Research and Development Company; Urbanization, Harland Bartholomew, president, Harland Bartholomew and Associates, St. Louis, Mo.; and health, Thomas Parran, head, graduate school of public health, University of Pittsburgh.

People

H. P. LIVERSIDGE, Fellow ASME, chairman of the board, Philadelphia Electric Company, received the William Penn Award of the Chamber of Commerce of Greater Philadelphia, at the group's annual dinner and meeting, held at the Bellevue-Stratford Hotel, Philadelphia, Pa., on Feb. 14, 1952. Mr. Liversidge was the first Philadelphian to receive this national award which is voted to the "American who has contributed decisively through industry."

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FORREST NAGLER, Fellow ASME, manager and chief engineer, atomic power section, Allis-Chalmers Manufacturing Company, Milwaukee, Wis., and inventor of the Nagler Runner, retired as of March 1, 1952. He has been an active member of ASME since 1918 and has served as a member of the Hydraulic Division Executive Committee, 1937–1938, and as chairman of that Committee, 1939–1940. He was a sponsor of the Committee on Hydraulic Prime Movers. He was vice-president of Region VI, 1949–1950. In 1921 Mr. Nagler was awarded a life membership for distinguished service for the best paper presented before the Society, entitled "A New Type of Hydraulic-Turbine Runner," which was published in ASME Transactions, vol. 41, 1919.

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D. B. PORTER, Mem. ASME, acting chairman of the department of industrial and management engineering, New York University, went to Germany to conduct "Directed Energy Round Tables." The round-table sessions are part of a new adult-education program being initiated in Europe and it is expected to help greatly in solving some of the existing difficulties. The German programs were sponsored by leading management societies including RKW (Rationalisierungs Kuratorium der deutschen Wirtschaft), REFA (Reichsausschuss für Arbeitsstudion), the Berlin Chamber of Commerce, the Free University of Berlin, and the Technische Akademie of Wuppertal.

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R. L. WELDON, Mem. ASME, president and general manager, Bathurst Power and Paper Company, Ltd., Montreal, and F. V. Seibert consulting engineer, Edmonton, have been awarded the Julian C. Smith Medals "for achievement in the development of Canada" by The Engineering Institute of Canada.

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STARR THAYER, a cathodic protection consultant, Houston, Texas, and E. A. Gulbransen, advisory engineer, Westinghouse Research Laboratories, East Pittsburgh, Pa., received the 1952 annual Frank Newman Speller and Willis Rodney Whitney Awards, respectively, from the National Association of Corrosion Engineers. The awards were presented at the annual banquet of the association, March 13, during the eighth annual conference and exhibition held at Galveston, Texas.

NEWARK COLLEGE OF ENGINEERING ASME STUDENT BRANCH PARTICIPATES IN TELEVISION PROGRAM

(The Newark College of Engineering student branch of ASME presented a television program, Feb. 11, 1952, over television Channel 13, station WATV of Newark, N. J. The program, "The Automobile Engine and Its Design," was sponsored by the Television Council for Higher Education in New Jersey and the Ford Foundation as one of a series of educational programs presented by several of the local colleges. Seven students from Newark College of Engineering, Frank Forte, George Matthews, Renato Rampi, John Commack, Glen Hersey, William Eager, and John Weigand, wrote the script for the program. Shown at speaker's table, *left to right*, are Messrs. Forte, Matthews, and Rampi, who presented the program on the television broadcast, after an introduction by Prof. G. B. Thom, Mem. ASME, chairman of the mechanical-engineering department, Newark College of Engineering. It is believed that this is the first time that a student branch of the Society has ever been telecast over a major channel.)

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D. K. BAILEY, National Bureau of Standards Central Radio Propagation Laboratory, received the Arthur S. Fleming Award as the outstanding young government man of the year. The award is given each year by the Washington Junior Chamber of Commerce which selects the man in government service under 36 years of age who has been of greatest service to the nation.

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W. R. G. BAKER, General Electric Company, received the Institute of Radio Engineers 1952 Medal of Honor at the annual banquet, held at the Waldorf-Astoria Hotel, New York, N. Y., March 5, 1952. Other awards presented at the banquet were: Morris Liebmann Memorial Prize to H. W. Welch, Jr.; Harry Diamond Memorial Award to Newborn Smith; The Institute Editor's Award to Jerome Freedman; and Vladimir K. Zworykin Television prize to B. D. Loughlin of the Hazeltine Electronics Corporation.

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LOUIS CORNIL, president of the International Committee of Scientific Management (CIOS), died in Brussels, Belgium, on Jan. 31, 1952. H. B. MAYNARD, Mem. ASME, one of the three deputy-presidents of CIOS, will serve as president of the organization. PROF. FRANCESCO MAURO, Mem. ASME, and founder-president of CIOS, died in Milan, Italy, Feb. 14, 1952.

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H. T. HEALD, Mem. ASME, Chancellor of The New York University, will receive the Washington Award for 1952 from the Western Society of Engineers, the American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers, The American Society of Mechanical Engineers, and the American Institute of Electrical Engineers at a dinner meeting, April 21, 1952, in Chicago, Ill.

SHOWN DURING A LUNCHEON AT WEST COAST INDUSTRIAL-ENGINEERING INSTITUTE BERKELEY, CALIF., FEB. 1, 1952, ARE, LEFT TO RIGHT, F. H. WICKHORST, MANAGER, INDUSTRIAL RELATIONS, KAISER CORPORATION, OAKLAND, CALIF.; D. G. MALCOLM, AND L. M. K. BOELTER)

West Coast Industrial-Engineering Conference Well Attended

OVER 600 West Coast engineers and managers attended the 4th annual Industrial-Engineering Institute of the University of California held in Berkeley on February 1 and 2, and in Los Angeles, for the first time, on February 4 and 5. These two-day meetings were presented by the University of California in co-operation with The American Society of Mechanical Engineers, the American Institute of Industrial Engineers, and the Society for the Advancement of Management.

D. G. Malcolm, Jun. ASME, assistant professor of mechanical engineering, University of California, and originator of the Institute, was general chairman, and R. M. Barnes, Mem. ASME, professor of engineering and production management at UCLA, served as chairman of the Los Angeles session.

The meetings at Berkeley and Los Angeles, which were identical except for the research papers presented, included talks at the following sessions: Organization for industrial engineering, work measurement, quality control, industrial-engineering philosophy, and results of industrial-engineering research.

Highlighting luncheon activities were talks by L. M. K. Boelter, Fellow ASME, dean of the college of engineering, UCLA, who spoke on "Engineering in Industry," and Robert Tannenbaum, associate professor of personnel management and industrial relations, school of business administration, UCLA, who discussed" Overcoming Barriers to the Acceptance of New Ideas and Methods."

The chairmen of various activities included E. P. DeGarmo, Mem. ASME; C. L. Taylor; E. C. Keachie, Mem. ASME; R. A. Galuzevski, Jun. ASME; F. T. Malm; R. R. O'Neill, Mem. ASME; and J. D. Carrabino.

Information concerning proceedings of the Institute may be obtained by writing D. G. Malcolm, University of California, Berkeley, Calif.

Brooklyn Polytechnic Institute Holds Open House

NEW Engineering equipment, ranging from a single device which heats a home in winter and then cools it in summer, to a wind tunnel which develops air flow comparable to 4000 mph were on display March 7, 1952, at the annual observance of Open House at the Polytechnic Institute of Brooklyn.

Invitations to inspect more than 100 laboratories and special exhibits were extended to high-school students and their counselors, parents, relatives and friends of the student body, members of the Polytechnic Alumni Association, and others interested in careers in science and engineering.

Microwave, servomechanisms, and industrial-electronics exhibits, ramjet-engine operation supersonic-flow demonstrations, photoelasticity tests, a stock-car engine operated by manufactured household gas, the velocity of sound in liquids, and demonstrations of the preparation of nylon, plastics, and synthetic rubber were included in the comprehensive program which provided an opportunity for visitors to observe a college of engineering in operation.

Among the laboratories open for the public were the hydraulic, mechanical, steam, internal-combustion, electrical measurements, machine foundry and welding, electric power, chemical instruments, chemical engineering, physical chemistry mechanism research, applied physics, aircraft structures, aerodynamics, transportation, soil mechanics, metalworking, and the Institute of Polymer Research with its many laboratories.

New equipment shown publicly for the first time included the following: In the mechanical-engineering department visitors saw a single heat-pump unit which can heat a home in the winter and cool it in the summer. This electrically driven compressor unit extracts heat from the earth through coils buried 10 ft deep in the backyard during the winter, and in the summer dumps the heat of the house into the ground, utilizing the same coils.

One of the few supersonic wind tunnels in the country reaching, on a test basis, a speed corresponding to approximately 4000 mph, in terms of the rate at which air can be made to flow past a fixed model in the test section, was operated for Open House guests, by the department of aeronautical engineering.

Other new equipment operated for the first time included an electrosonometer and an oscillograph for testing the structural strength of construction materials weighing up to 1500 lb; a student-built Francis-type reaction water turbine used for the conversion of water power to electrical energy, and new Swiss surveying equipment, lighter and more compact than comparable standard apparatus, all to be found in the department of civil engineering, a plenum chamber in the department of mechanical engineering for testing air-delivery devices such as fans, blowers, and compressors; an experimental drier, one of three so far in use in this country and South America, which can be operated at any humidity on materials, drying and chemical research apparatus with which new heat-resistant plastics are being developed at the Polymer Institute.

High-Temperature Properties of Stainless Steels

AN EXTENSIVE 130-page report, which is essentially a graphical summary of elevated-temperature data for the commercially produced stainless steels, has been issued under the auspices of the Data and Publications Panel of the ASTM-ASME Joint Committee on Effect of Temperature on the Properties of Metals.

Included are summary curves for tensile strength, 0.2 per cent offset yield strength, per cent elongation, per cent reduction of area, stresses for rupture in 100, 1000, 10,000, 100,000 hr, and stress for creep rates 0.0001 and 0.00001 per cent per hr (1 per cent in 10,000 and 100,000 hr).

An appendix is included, which contains the primary data from which the summary curves are drawn. The data sheets in the appendix also give the chemical composition, processing data, and other pertinent information about the steels included in this survey.

Copies of publication No. 124, "Report on the Elevated-Temperature Properties of Stainless Steels," January, 1952, are available from the American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa., at $4 a copy; $3 to ASTM and ASME members.

Actions of the ASME Executive Committee

At a Meeting at Headquarters, Feb. 19, 1952

A MEETING of the Executive Committee of the Council was held in the rooms of the Society on Feb. 19, 1952. R. J. S. Pigott, chairman, presided. In addition to Mr. Pigott, there were present: H. R. Kessler, T. E. Purcell, R. A. Sherman, and W. F. Thompson of the Executive Committee; E. J. Kates, assistant treasurer; E. G. Bailey, past-president; H. E. Martin, director at large; C. E. Davies, secretary; and Ernest Hartford, executive assistant secretary.

Dinner Meeting

It was reported that a dinner meeting was held on February 18 at which members of the Executive Committee met with ASME representatives on the United Engineering Trustees, Inc., Engineering Foundation, and the Engineering Societies Library to discuss operating problems of those organizations. Informal suggestions were offered for consideration and guidance. There were present: R. J. S. Pigott and W. F. Thompson of the Executive Committee; H. E. Martin, director at large; E. J. Kates, assistant treasurer; K. M. Irwin, chairman, Organization Committee; R. F. Gagg and J. L. Kopf, representatives on UET; H. Weisberg and E. L. Robinson, representatives on Engineering Foundation; T. Baumeister, representative on Library; J. H. R. Arms, secretary, UET; R. H. Phelps, director, Library; C. E. Davies, secretary; and Ernest Hartford, executive assistant secretary.

Committee on Air-Pollution Controls

The Executive Committee of the Council voted to authorize the allotment from the B-Development fund up to $10,000 for the work of the Committee on Air-Pollution Controls for the remainder of the fiscal year 1951–1952, and up to $20,000 from the B-Development Fund for its work for the fiscal year starting Oct. 1, 1952; and to request the Committee on Air-Pollution Controls to present a more detailed budget for the fiscal year 1952–1953 by Oct. 1, 1952.

Committee on ASME Staff Personnel

Appointment of J. M. Todd, as chairman, and W. F. Thompson and H. E. Martin as members of the Committee on ASME Staff Personnel for two-year terms was announced. Other members of the Committee for 1952 are B. P. Graves and S. D. Moxley.

Roy V. Wright Lecture

On recommendation of the Board on Public Affairs, it was voted to approve the selection of Baldwin M. Woods, University of California, Berkeley, Calif., as the Roy V. Wright Lecturer at the Seattle Spring Meeting.

Spring Meeting

The advisability of holding an informal meeting of the Council during the Spring Meeting in Seattle was discussed. It was decided not to schedule such a meeting because of the expense involved.

Certificates of Award

A certificate of award was approved for E. H. Barlow, retiring member and former chairman of the Admissions Committee.

On recommendation of their respective vice-presidents, certificates of award were presented to the following Regional committeemen:

Student Branch Committees—Z. R. Bliss, Region I; M. E. Turner, Region IV.

Sections Committee—R. A. Martin, Region IV.

Engineers Joint Council

At its January 25 meeting the Engineers Joint Council voted to refer the final report of the Exploratory Group on Unity of the Engineering Profession to the EJC constituent societies for study and report back to EJC. The Executive Committee of the ASME Council voted to submit to the Council for letter-ballot action closing March 10, 1952, the following recommended action:

"The ASME Council (*a*) approves in principle the Report of the Exploratory Group to Consider the Increased Unity of the Engineering Profession, dated December, 1951; (*b*) requests Engineers Joint Council to take steps to amend its constitution as recommended in that report."

Upon the close of the ballot, the secretary is authorized to inform the Engineers Joint Council of the result.

Appointments

The following appointments on committees and joint activities were approved: Eugene W. O'Brien, Organization Committee; Gilbert I. Ross and Stanley Stokes, Nuclear Energy Application Committee; C. D. Wilson, Special Standards Committee on Steam Turbines; Frank J. Bishop, Frank J. Drogosch, and L. R. Cardwell, Boiler Code Conference Committee; and J. C. Souder, Boiler Code Subcommittee on Unfired Pressure Vessels.

Lehigh University to Enlarge Fritz Laboratory

THE world's largest vertical universal testing machine is to be installed in a new building to adjoin historic Fritz Engineering Laboratory on the Lehigh University campus, Bethlehem, Pa., M. D. Whitaker, president of the University, announced recently. Total cost of the new equipment and building, to be ready for the opening of the academic year starting September, 1954, is estimated at approximately $1,200,000.

In announcing the new plans to make the Fritz Laboratory testing center the most complete in the nation, Dr. Whitaker said that the new installation will be made in cooperation with the Bethlehem Steel Company.

In making public the plans, approved by the University's board of trustees, Dr. Whitaker said, "the purpose of a structural-testing laboratory at a university is to expand knowledge of the properties of engineering materials and of the behavior of engineering structures and to train personnel for positions in the structural and allied industries. This new testing center will furnish special testing facilities not now available to separate companies or engineering research-investigation groups as well as provide for more varied student demonstrations."

The new building will house a 5 million-lb-capacity hydraulic tension-compression machine to be constructed at an estimated cost of $400,000; accessory equipment valued at $300,000, and modern laboratories which will widen the scope of testing in every field.

Fritz Laboratory was established on the Lehigh University campus in 1909 by John Fritz, who was president of ASME in 1896, a trustee of the University since its founding in 1865 by Asa Packer. The present building, 94 ft wide and 115 ft long, was fitted with an 800,000-lb Riehle universal testing machine and seven similar machines of lesser capacity. When installed, this 800,000-lb machine was the largest vertical universal testing machine in the country.

NSF Approved Grants for Rome Meeting

THE National Science Foundation made travel grants to four American mathematicians to permit their attendance as members of the United States delegation to the first general assembly of the International Mathematical Union in Rome, Italy, March 6–8, 1952. These were the first travel grants to be made under the Foundation's program to provide for the attendance of American scientists at international scientific meetings.

The four grantees are J. R. Kline, University of Pennsylvania, Philadelphia; Saunders MacLane, University of Chicago; Einer Hille, Yale University, New Haven; and G. P. Whyburn, University of Virginia, Charlottesville; M. H. Stone, University of Chicago, served as chairman of the United States delegation. Nathan Jacobson, Yale University and W. R. Transue, Kenyon College, Gambier, Ohio, were alternate members of the delegation.

Re-Evaluation of Engineering Manpower Supply Stressed at NYU Conference

FOR the next five to seven years industry's requirements for engineers and technically trained personnel will so far exceed the available supply that a complete re-evaluation must be made of the work in which these specialists are currently engaged. This was the conclusion reached by a group of educators and engineering executives from the New York metropolitan area at a recent conference sponsored jointly by the New York University College of Engineering and *Product Engineering*.

It was further agreed that greater use probably will be made of technical assistants and of

students who have failed to complete a four-year course leading to an engineering degree.

The conference revealed that while approximately 52,000 engineering students were graduated in 1950, most of them veterans, the figure dropped to 38,000 in 1951, and will decline to approximately 26,000 this year. Statistics for 1953 and 1954 indicate that the anticipated number of graduates for each of these years will not exceed 17,000. In sharp contrast to these predictions, industry has placed as its current minimum requirement 30,000 engineering graduates per year, and it is estimated that by 1954 this number will rise to 36,000.

The increased specialization of industry has been a major factor in creating the present need. Companies whose products are primarily industrial require technicians for sales positions, and manufacturing firms are constantly finding additional use for the engineer. The old-line shop personnel who have risen from the toolroom to supervisory positions are departing from the scene and must be replaced by graduate engineers.

Certain consolidation steps already have been taken by industry, including a speed-up in the courses through which graduates are trained after being hired. In this respect, there is considerable interest in a program being carried on by one of the major aircraft-engine manufacturing concerns of the metropolitan area. A series of psychological tests is employed to determine the most suitable job for an engineering graduate at that plant.

By this method the standard practice of placing the graduate on the "test stand" for as long as two years before assigning him in a capacity where he can make significant contributions has been shortened to as little as six months. All data have not yet been analyzed on these procedures, but preliminary results indicate that the tests are successful beyond initial expectation.

It was further disclosed that the time is rapidly approaching when many qualified students can no longer pay the high cost of a college education. Outside support of able students will be required and may come from the federal or state governments or private industry. However, the conditions under which the aid may be provided need both debate and clarification.

In order to attract high-caliber students into the profession, industry must make a tremendous effort to acquaint juniors and seniors in high school with the advantages and rewards of an engineering education.

First International Underground Coal Gasification Conference Held Recently

THE first International Conference on Underground Gasification of Coal, to be sponsored jointly by the Bureau of Mines and the Alabama Power Company of Birmingham, Ala., was held February 12–14, 1952, instead of January 28–30, as originally planned.

The postponement was necessary in order to permit greater participation by European scientists in the sessions, which were held at Birmingham and Gorgas, Ala.

The conference included presentation of papers and technical discussions at Birmingham and inspection of the co-operative underground-gasification experiment that the Bureau and the power company are conducting at Gorgas. This is the third experiment of its type that the Bureau and the company have carried on there since 1947. The first lasted 50 days, the second 22 months, and the current one has been in progress since late last June.

W. C. Schroeder, Mem. ASME, assistant director of the Bureau, and M. H. Fies, consultant to the Bureau and manager of coal operations for the Alabama Power Company, who were instrumental in bringing the conference to this country, served as co-chairmen of the conference.

From Birmingham the foreign visitors went to New York, N. Y., for a symposium on coal gasification and hydrogenation in connection with the annual meeting of the American Institute of Mining and Metallurgical Engineers, February 20, 1952. The Bureau is sponsoring and assisting in arranging this symposium.

Subsequently, the visiting scientists will inspect Bureau installations at Louisiana, Mo., Pittsburgh and Bruceton, Pa., and Morgantown, W. Va., where research on the production of liquid fuels involving above-ground coal gasification is conducted. They also will visit private research laboratories and industrial concerns. Before returning to their home countries, they will spend some time at Washington.

AOA Carbide Cutting Tool Subcommittee Functions as Data Clearinghouse

THE American Ordnance Association now has in full operation a carbide cutting tool subcommittee of its Shell Committee. Representing all manufacturers of tungsten-carbide cutting tools, the committee is serving as a clearinghouse for carbide tooling data and on carbide problems arising in shell manufacturing.

All available technical data on application of carbides in shell manufacture has already been reviewed and a list is available to shell producers. Additional bulletins and the like are being reviewed as rapidly as issued by individual carbide-tool companies. Shell producers are being advised of such additional bulletins as soon as they are approved by the carbide cutting tool subcommittee.

Assistance is also being provided to shell producers by the carbide committee on the organization of training programs relating to the application of carbides in shell production.

Information as to available carbide tooling data and communications regarding carbide tooling problems in shell manufacture should be addressed to J. S. Gillespie, chairman, Carbide Cutting Tool Subcommittee, American Ordnance Association Shell Committee, c/o Carboloy Department of General Electric Company, Box 237, Detroit 32, Mich.

Meetings of Other Societies

April 21–24
Society of Automotive Engineers, national aeronautic meeting and aircraft engineering display, Hotel Statler, New York, N. Y.

April 27–May 1
The American Ceramic Society, 54th annual meeting, William Penn Hotel, Pittsburgh, Pa.

April 28–29
Association of Iron and Steel Engineers, spring conference, Netherlands-Plaza Hotel, Cincinnati, Ohio

April 28–30
Chamber of Commerce of the United States, 40th annual meeting, Statler and Mayflower Hotels, Washington, D. C.

May 1–7
American Foundrymen's Society, international foundry congress and show, Atlantic City, N. J.

May 4–8
The Electrochemical Society, 50th anniversary and spring meeting, Benjamin Franklin Hotel, Philadelphia, Pa.

May 4–9
American Water Works Association, annual meeting, Municipal Auditorium, Kansas City, Mo.

May 5–7
Engineering Institute of Canada, Vancouver Hotel, Vancouver, B. C., Can.

May 7–9
Purdue University, industrial waste conference, Purdue Memorial Union, Lafayette, Ind.

May 11–14
American Institute of Chemical Engineers, spring meeting, French Lick Springs Hotel, French Lick, Ind.

May 14–16
Society for Experimental Stress Analysis, spring meeting, Hotel Lincoln, Indianapolis, Ind.

Sept. 3–13
Centennial of Engineering, Chicago, Ill.
(For ASME Calendar of Events see page 347)

Screw Threads Committee (ISO)

THE Screw Threads Committee of the International Organization for Standardization (ISO) session dates have been set for June 11 through 14, at Columbia University, New York, N. Y. These sessions will be held in conjunction with the triennial meeting of the ISO at Columbia, June 9–21, 1952. American Standards Association, U. S. member of the ISO, will act as host.

Twenty-one nations, including the United States, actively participate in the international program of thread unification. American industry is the largest producer of bolts, nuts, and screws, as well as the countless other articles in which threads are used.

Sweden holds the secretariat for the project on screw threads. The countries actively participating in this work are Austria, Belgium, Canada, Denmark, Finland, France, Hungary, India, Israel, Italy, The Netherlands, Norway, Poland, Portugal, Rumania, Sweden, Switzerland, Czechoslovakia, United Kingdom, United States, and the Union of Soviet Socialist Republics.

The ISO is the international clearinghouse for the national standards bodies of 33 nations. It is recognized under the United Nations as the authoritative channel through which standardization on an international level is carried out.

UNESCO Work Group 9 Drafts Peace Recommendations and Conclusions

DURING the Third National Conference of the U. S. National Commission for UNESCO, held at Hunter College, New York, N. Y., Jan. 27–31, 1952, Work Group 9 (Natural Scientists and Engineers) drafted some conclusions and recommendations on the opportunities for scientists and engineers to contribute to peace through the United Nations system. John S. Nicholas of Yale University, presided. Ralph L. Goetzenberger, Fellow ASME, is representative of Engineers Joint Council on the Commission.

A summary of the conclusions and recommendations follows:

The scientific method is universal. The results of scientific study are of value to all nations. While the promotion of science for its own sake is not the prime objective of UNESCO, the chartered objective of UNESCO cannot be achieved without encouraging or promoting both basic and applied science as a means to an ultimate end.

The group trusts that the U. S. National Commission recognizes the past achievements and the important role of UNESCO's work in the basic and applied sciences and requests the Commission to urge that there be no reduction in the limited funds now allotted for the key items of the present national science program; notably, technical assistance in the field sciences co-operation offices, grants-in-aid, international research laboratories, and documentation and abstracting.

Unnecessary and undesirable restrictions on exchange of information and travel of scientists exist in certain countries, including the U. S. A. Free exchange of information and facilitation of travel are both essential to scientific progress and human welfare.

UNESCO's grants-in-aid have proved effective in facilitating international co-operation of scientists and engineers. It is recognized that continuing problems of evaluation are to be faced and that a balance must be struck between basic and applied science as regards support within the limited UNESCO budget. Assistance to medical and engineering sciences must be brought up to the level of support for the more basic sciences.

The International Computation Center should be put in operation promptly.

The group emphasizes that research, particularly "to improve the living conditions of mankind," must include improved food production, better utilization of minerals, metals, and other natural resources, wider use of technical skills and improvements in public health.

The group recommends the formation of a research council to consider the mineral-resources problem on a world basis.

It is felt that the services of the engineering profession have not been adequately utilized in the program of UNESCO. It is urgent, therefore, that Engineers Joint Council be invited to submit proposals with a view to utilization and services in the broadest possible ways in the future activities of UNESCO. An initial survey of proposals for transmission to the secretary of the National Commission was appended.

Further intensive study of the problems involved in effective abstracting and indexing is recommended, including consideration of possible new techniques.

An increasing trend to mention only U. S. research reports in literature citations in U. S. scientific publications is deplored. Two fields in which this trend can be reduced are: More efficient abstracting and indexing on an international level; and calling the question to the attention of college and university teachers.

The group recognizes the need for facilitation of freedom of movement of goods and sources in the development of resources in the interests of world tranquility.

It recognizes the importance of population in relation to resources and urges that this problem be given serious consideration by UNESCO.

It notes with approval the interdisciplinary conferences sponsored by UNESCO and recommends continuation and expansion.

Gaillard Industrial Standardization Seminar Announced

SEVENTEEN organizations were represented at the private seminar on industrial standardization held in New York, N. Y., Jan. 21 through 25, 1952, by John Gaillard, Mem. ASME, mechanical engineer on the staff of the American Standards Association, and lecturer at Columbia University.

The seminar was attended by executives in charge of such functions as standardization, product design, research and development, inspection, or quality control. Their diversified backgrounds, combined with their common interest in the systematic organization and management of company standardization work, led to highly informative round-table discussions following Dr. Gaillard's lectures at the ten conferences.

Increasing interest in the seminar shown by industrial executives and technical experts has prompted Dr. Gaillard to hold another five-day session, in the Engineering Societies Building, 29 West 39th Street, New York, N. Y., June 23 through 27, 1952.

Further information may be obtained by writing Dr. Gaillard at his home address, 400 West 118th Street, New York 27, N. Y.

Coming Meetings

Welding Conference

A BROAD-GAGE inquiry into all aspects of present-day modern welding techniques and problems characterizes the program for the third annual Welding Conference at Detroit, Mich., on April 16–18, 1952.

Meetings at Rackham Memorial Building will be addressed by a score of authorities in different fields. In addition, exhibits of welding equipment will be displayed. These meetings are under the sponsorship of three technical groups, the American Institute of Electrical Engineers, the Detroit section of the American Welding Society, and the Industrial Electrical Engineers Society of Detroit.

The program includes papers on the following subjects: Quality control, instrumentation, power supply, resistance welding, fundamental arc, and arc welding.

Air-Pollution Symposium

THE second National Air Pollution Symposium will be held May 5–6, 1952, at the Huntington Hotel, Pasadena, Calif. The meeting is expected to attract several hundred scientists, engineers, technical workers, and executives interested in phases of air pollution affecting industrial communities.

Under the sponsorship of Stanford Research Institute, in co-operation with the California Institute of Technology, the University of California at Los Angeles, and the University of Southern California, sessions will follow the general pattern of the successful first symposium held under the same auspices in 1949.

The program will cover general topics of new techniques in sampling, analysis and instrumentation, fundamental chemistry and physics of the atmosphere, the contribution of

ASME Calendar of Coming Events

June 15–19
ASME Semi-Annual Meeting, Sheraton-Gibson Hotel, Cincinnati, Ohio
(Final date for submitting papers was Feb. 1, 1952)

June 19–21
ASME Applied Mechanics Division Conference, The Pennsylvania State College, State College, Pa.
(Final date for submitting papers was Feb. 1, 1952)

June 23–27
ASME Oil and Gas Power Division Conference, Hotel Statler, Buffalo, N. Y.
(Final date for submitting papers was Feb. 1, 1952)

June 26–28
ASME Applied Mechanics Division, West Coast Conference, University of California, Los Angeles, Calif.
(Final date for submitting papers was Feb. 1, 1952)

Sept. 8–11
ASME Fall Meeting, Sheraton Hotel, Chicago, Ill.
(Final date for submitting papers—May 1, 1952)

Sept. 8–12
ASME Industrial Instruments and Regulators Division and Instrument Society of America Exhibit and Joint Conference, Cleveland Auditorium, Cleveland, Ohio
(Final date for submitting papers—May 1, 1952)

Sept. 22–24
ASME Petroleum Mechanical-Engineering Conference, Hotel President, Kansas City, Mo.
(Final date for submitting papers—May 1, 1952)

Oct. 30–31
ASME Fuels and AIME Coal Divisions Joint Conference, Bellevue-Stratford Hotel, Philadelphia, Pa.
(Final date for submitting papers—June 1, 1952)

Nov. 30–Dec. 5
ASME Annual Meeting, Statler Hotel, New York, N. Y.
(Final date for submitting papers—July 1, 1952)
(For Meetings of Other Societies see page 346)

internal-combustion engines, and biological aspects of atmospheric contamination. Management's views on air pollution will be introduced.

Members of the executive committee for the 1952 symposium are F. C. Lindvall, Mem. ASME; L. M. K. Boelter, Fellow ASME; R. E. Vivian; and A. M. Zarem, chairman. Headquarters for NAPS have been established at Room 332, 612 South Flower Street, Los Angeles, Calif.

AIIE Industrial-Engineering Clinic

THE Dayton chapter of the American Institute of Industrial Engineers will sponsor a two-day clinic, with increasing production efficiency through methods improvement, work measurement, and wage incentives to be the chief subject, May 8-9, 1952, in Dayton, Ohio.

R. M. Barnes, Mem. ASME, professor of engineering and production management, University of California and Western vice-president of AIIE, will conduct the sessions. Dr. Barnes is internationally known for his work in the field of industrial engineering. He is the author of tests which have become standard reference works in time and motion study, work simplification, and related subjects. For ten years he has conducted the famous summer management course at the University of Iowa.

Subjects covered in this intensive course will be: Objectives of industrial engineering, motion study and its tools, methods of increasing worker productivity, process analysis, equipment utilization, design of a methods training program, work measurement, time study, elemental data, motion-time data, performance rating and accepted practice in these fields; and fundamentals of a successful wage plan and why some plans fail. Those attending will also have an opportunity to participate in Dr. Barnes's work-measurement survey.

Information regarding the clinic and the 1952 national convention of AIIE which follows on May 10 may be obtained from R. E. Allen, The Univis Lens Company, 401 Leo Street, Dayton 1, Ohio.

Atomic Energy Conference

DEVELOPMENT of an educational program designed to spread information on the facts and future of atomic energy was announced by Michigan State College. The first phase of the program is to be a two-day conference titled "Atomic Energy and the Future," on May 20-21, 1952.

Specialists in peacetime usage of atomic energy from the Atomic Energy Commission's Argonne National Laboratory, Chicago, Ill., have been invited to take part. Invitations also have gone out to nuclear-energy experts from the Massachusetts Institute of Technology and the University of North Carolina to join MSC men who have been conducting research with radioactive isotopes. Both the Dow Chemical Company, Midland, Mich., and the Detroit Edison Company have agreed to co-operate.

Emphasis in the conference will be placed on possible uses of atomic energy in industry for power generation. Planning officials are operating on the assumption that persons attending will have no prior knowledge of the subject.

Sponsors of the program are the college's department of mechanical engineering and the continuing education service. Further information may be obtained from Prof. D. J. Renwick, mechanical-engineering department, who is program chairman, or from Stanfield Wells, continuing education service.

Quality-Control Convention

HIGH LIGHTS of the forthcoming sixth annual convention of the American Society for Quality Control to be held in Syracuse, N. Y., on May 22-24, 1952, include several discussions by outstanding American industrialists on quality control and its applications to their own business.

The program has been planned to provide technical discussions and papers in the following fields: Aircraft and aircraft industries, automotive, die stamping, electronics, gaging and gage laboratory, mathematical statistics, precision manufacture, receiving and in-process inspection, textiles and textile machinery, Armed Forces procurement, chemical, education, food, management, office and accounting, pulp and paper, steel foundry and fabrication, and vendor certification.

In addition to extensive coverage of these subjects, 11 hours of instruction will be devoted to the basic principles of the quality-control idea.

The exhibits will include those of many of the country's foremost manufacturers showing important phases of quality-control activities in their operations, as well as most of the outstanding gage companies displaying the latest and best in gaging equipment.

Michigan State College Fellowships Announced

THE Board of Trustees of the Alumni Fund of Michigan State College, East Lansing, Mich., offer seven predoctoral and one post-doctoral fellowship for study at Michigan State College. The fellowships are open to qualified candidates in any field of research for which Michigan State College has the appropriate facilities. Inquiries should be addressed to the Dean of the School of Graduate Studies, Michigan State College, East Lansing, Mich. Completed applications must be received before May 1, 1952.

Junior Forum

When to Change Jobs

By Joseph Schmerler[1]

WHEN engineering jobs are scarce and the available manpower is greater than the job supply, the pressing question for young graduates is, "How do I find a job?" All other considerations which constitute "job satisfaction" become of secondary importance so long as there is a pay check.

Today, employment prospects for engineers are good. Jobs are becoming more and more plentiful and manpower scarcer, so that industry, government, and the armed forces are in keen competition for the available supply. How should the young engineer respond to this situation? If he has a satisfactory job, should he try to improve his position by joining another company? Should he transfer to a defense industry where the wages are obviously higher? Should he change to an industry which has always interested him but where he previously could not find employment? Or, should he stay at his present job?

This question of whether or not to change jobs is always before the engineer who is not completely satisfied with his job. Now that opportunities for change exist, the matter comes in for serious consideration. Obviously, the answer is not so simple a matter as arithmetical addition or subtraction. The solution is not always the same. It depends entirely on the emphasis placed on the various qualities which determine job satisfaction.

[1] Design Engineer, Celanese Corporation of America, New York, N. Y. Jun. ASME.

Job Evaluation Guide

In considering what a man should expect of his job, the Junior Group of the Boston Section, ASME, last fall sponsored a discussion entitled "When to Change Jobs." As a guide in this evaluation, the following five points were offered by C. R. Soderberg, Fellow ASME, professor and head, mechanical-engineering department, Massachusetts Institute of Technology: Opportunities for creative work in your chosen field, opportunities for wide contacts with professional and business colleagues, satisfactory pay, premises for advancement, and congenial surroundings.

The first item in this check list gives basic consideration to the proper utilization of the individual's engineering talents. A technical education should not mark a man simply for calculation work. He should be allowed to make broader contributions to the general planning of the project. Such work enables a man to go to his job each day with the urge of enthusiasm and anticipation instead of feeling that he is being dragged to the "salt mines."

The second point, contact with colleagues, is divided into business and professional associations. On the job there should be constant opportunity for addition to one's store of technical information. Company colleagues can be of immeasurable assistance toward this end. Often, company-sponsored discussion sessions are held to familiarize the general

engineering staff with work being carried on by the individual sections.

Association on the professional level should be sponsored by the company through endorsement of active participation in engineering societies. Technical personnel should be encouraged to attend society conventions and regional meetings where association with one's colleagues can be carried further and where a great mass of engineering information can also be gathered.

The consideration of satisfactory pay is of course in sharp focus with the increasing cost of living. This may be the most important motivation in the decision whether or not to change one's job. Some young engineers, therefore, change jobs whenever seemingly better jobs become available. Dean Alexander of Northeastern University recently had the opportunity of studying the records of a large group of graduates in mechanical engineering and obtained a random sample of 275 men. It was possible to observe the number of jobs held over a certain period of years as compared to the importance of the later positions occupied. It was clearly indicated that equal progress was made by men who had never changed jobs and by men who had frequently changed employers. It is apparent that a change is indicated when, after careful analysis, only a limited scope of experience can be obtained with one's present employer.

Very closely integrated with salary consideration is the prospect for advancement. When a young man develops qualities of personality, leadership, business judgment, salesmanship, and is able to cope with company policies successfully, he must be given an opportunity for advancement. Such a company has "integrity." This means a good business reputation, fair dealings with employees as well as with customers and suppliers, and freedom from intrigue within the organization.

The final point for consideration is congenial surroundings. The previously mentioned points are mainly responsible for this attitude. Management which is seriously concerned with developing and keeping competent personnel will see to it that the surroundings are congenial.

Through this list of considerations, it can be seen that the young engineer must demand two parallel avenues of advancement—within his profession, as well as within his company of employment. These two avenues do not necessarily maintain the same relative significance throughout one's life. Later in life the immediate concern of the firm tends to become dominant. Also, the element of security becomes of greater importance. To a man of 50, security of employment is a real thing while to the young engineer excessive preoccupation with security is unprofitable.

If analysis of this check list indicates unsatisfactory progress in any of the considerations, and the young engineer has given complete loyalty to his company, without reservation, it is time to consider a change. If he has ability, confidence, and professional standing, it should not be difficult for him to sever one connection with its maze of local ties and enter another.

ASME Standards Workshop

Interpretations of Code for Pressure Piping

FROM time to time certain actions of the Sectional Committee B31 will be published for the information of interested parties. While these do not constitute formal revision of the Code, they may be utilized in specifications, or otherwise, as representing the considered opinion of the Committee.

Pending revision of the Code for Pressure Piping, ASA B31.1—1951, the Sectional Committee has recommended that ASME, as sponsor, publish selected interpretations so that industry may take immediate advantage of corresponding proposed revisions.

Cases 1, 2, 3, 4, 5 Canceled

Cases 1, 2, 3, and 4 have been annulled because the provisions of these cases had been incorporated into the present edition of B31.1.

Case 5 has been annulled because the stresses provided by this case are lower than the new sttesses adopted by the Boiler Code and therefore this case is not necessary.

Case 7 Correction

Section E of this case was inadvertently omitted. Section E should read: "60 per cent of the average or 80 per cent of the minimum stress to produce rupture in 100,000 hours as reported by test data."

Surface Qualities

Sectional Committee on Classification and Designation of Surface Qualities (B46) met in the Engineering Societies Building, New York, N. Y., Feb. 14, 1952. Louis F. Polk, president, Sheffield Corporation, Dayton, Ohio, was presented as chairman of the committee. Mr. Polk was graduated from Miami University with an AB degree in 1926. He is coauthor of "Dimensional Control," and author of numerous technical articles. He is active in several professional and industrial organizations.

The committee authorized the appointment of three subcommittees: (1) to establish numerical values of roughness width specifications, (2) to review and revise the existing standard (B46.1—1947) on roughness to bring it up to date with current practice, and (3) to investigate the need for and to propose a standard on surface roughness instrumentation characteristics.

Machine Tool Elements

Sectional Committee on Small Tools and Machine Tool Elements (B5) has circulated for letter-ballot vote a proposed American Standard on Mounting Dimensions of Lubricating and Coolant Pumps for Machine Tools. In preparing the draft, the committee has worked in co-operation with the National Electrical Manufacturers Association on questions where motor mounting dimensions were concerned. The proposed standard covers mounting dimensions both for the type of pump that is attached directly to the machine tools and also the type of pump attached to motors which, in turn, are attached to the machine tools. "Every attention has been given to establish dimensions that encourage improvement and further development in both pumps and motors," the Foreword to the proposal declares.

Engineering Societies Personnel Service, Inc.

These items are from information furnished by the Engineering Societies Personnel Service, Inc., in co-operation with the national societies of Civil, Electrical, Mechanical, and Mining and Metallurgical Engineers. This Service is available to all engineers, members or not, and is operated on a nonprofit basis. In applying for positions advertised by the Service, the applicant agrees, if actually placed in a position through the Service as a result of an advertisement, to pay a placement fee in accordance with the rates as listed by the Service. These rates have been established in order to maintain an efficient nonprofit personnel service and are available upon request. This also applies to registrant members whose availability notices appear in these columns. Apply by letter, addressed to the key number indicated, and mail to the New York office. When making application for a position include six cents in stamps for forwarding application to the employer and for returning when necessary. A weekly bulletin of engineering positions open is available at a subscription of $3.50 per quarter or $12 per annum for members, $4.50 per quarter for nonmembers, payable in advance.

New York	Chicago	Detroit	San Francisco
8 West 40th Street	84 East Randolph Street	100 Farnsworth Ave.	57 Post Street

Men Available[1]

Industrial Engineer, 28, BS engineering, MS industrial relations. Five years' industrial experience including two in methods engineering; one and a half years teaching industrial engineering. Desires college teaching position in industrial engineering or personnel administration. Me-871.

Mechanical Engineer, 27, married, BSME, Notre Dame. EIT, N. Y. Experience, three years instructor machine design and allied courses; two years practical design mechanisms and heavy machinery field. Prefers East. Me-872.

[1] All men listed hold some form of ASME membership.

Positions Available

Junior Project Engineer, ME degree or equivalent, plus two years' experience, to assume responsibility of the development of a specific portion of a semicomplex component. Coordinate engineering problems with vendors or subcontractors. U. S. citizen. $3380. N. J. Y-6640.

Engineers. (a) Development engineers, mechanical engineering graduates for development of recording, indicating, and controlling instruments for application to industrial process operation and control. Recent graduates or men with one or two years' development experience will be considered. $3600–$4500. (c) Design engineers,

mechanical graduate, with or without one or two years' experience in mechanical design. Design work will be on instruments for recording, indicating, transmitting, and controlling pressure, temperature, flow, liquid level, etc., for operation and control of industrial processes. $3600–$4500. Company will pay employment fees. Conn. Y-6642.

Engineers. (*a*) Chief machine designer, with training and experience in field of automatic machine design, mechanical degree, five to ten years' experience. $7200. (*b*) Machine designer, mechanical degree, five to ten years' experience capable of design on precision automatic equipment with particular emphasis on electronic tube mounting machines. $6000. (*c*) Machine designer ME, degree or equivalent, five to ten years' experience, capable of design on precision automatic equipment with particular emphasis on grid-winding machines. $6000. (*d*) Associate design engineer with special knowledge of burners, combustion, and furnace design, engineering degree. $4800–$5100. (*e*) Drafting-room supervisor to supervise drafting room of ten mechanical draftsmen with several tool and jig designers. $4500. Upstate N. Y. Y-6645.

Engineers. (*a*) Product engineer, 28–40, mechanical or electrical graduate, at least five years' product-design or development experience, including at least two years shop contact work with heavy machinery, and knowledge of cost estimating, service requirements, and manufacturing processes required for economical production. Responsibilities will include development, design, specifications, testing, production, and application engineering problems. $6000–$7000. (*b*) Experimental engineer, 25–35, chemical or mechanical graduate, at least two years' testing or research experience. Will make research tests on experimental machines and new products. Prepare engineering reports and product specifications for use by engineers in designing new equipment. $4500–$5500. Upstate N. Y. Y-6650.

Engineers. (*a*) Office engineer, to take charge of drafting room. Should be technical graduate, preferably BS in ME, 28–40, at least five years' experience in the drafting room. Will supervise the designers and draftsmen and be responsible for the correct filing of all drawings and engineering records. $4800–$7200. (*b*) Mechanical engineer, BS degree preferred, 25–40, considerable experience in drafting and design work. Must be willing to work on the board as design engineer, in the design of mechanical layouts. Will be given special mechanical problems to investigate as well as make recommendations for improvement of present equipment. $4200–$6000. Cuba. Y-6658.

Factory Superintendent, about 50, thorough knowledge of taps, tools, and gages, as well as milling and tapping machines, turret lathes, and thread grinders. Position will largely be out on the floor supervising the work of 60 to 70 men, in addition to the necessary paper work. $8000–$10,000. Conn. Y-6659.

Engineers. (*a*) Chief design engineer, mechanical graduate preferred, five to ten years in an engineering department and at least two years' experience in organizing and administrating the efforts of others. Must be strong on tooling problems, methods, and ability to organize and operate a department. Responsible for the operation of an engineering department which takes over the design after the development of any product has been completed. (*b*) Chief inspector, preferably mechanical graduate, with good grounding and experience in the principles and theories of quality control, methods of sampling, etc. Should have at least five years' shop and inspection experience, particularly with regard to machine-tool work and two years' experience in organizing and supervising the efforts of others. Responsible for the operation of an inspection and test department. (*c*) Factory superintendent, at least five years' close experience with machine tools, and at least two years' supervision of a machine-tool department, engineering degree, preferably mechanical. Responsible for operation of a machine shop, toolroom, stock rooms, assembly departments, shipping and receiving departments. Mich. Y-6669.

Administrative Engineer, mechanical graduate, at least six years' design and manufacturing experience on auto, trucks, or heavy equipment covering design, production, patents, specifications, reports, manuals to assist chief engineer on liaison with customers, engineering, manufacturing, and service. $7200. Eastern Pa. Y-6670.

Industrial Engineer, from three to five years' experience in plant layout, standards operation-sheet writing, and tools, for manufacturer of small component parts. To $6000. N. Y. State. Y-6672.

Mechanics Engineer, young, for small, growing company engaged in the design, development, and manufacture of magnetic recording equipment: magnetic tape for motion-picture sound. Must have had experience or be interested in magnetic tape field or sound field or in the optical field. Salary open. N. J. Y-6673.

Machine Designers, 35–45, to act as group leaders. (*a*) for machines that utilize abrasive materials such as grinding machines, etc.; (*b*) for milling machines, cutters, etc. $10,000 and up. Conn. Y-6688.

Engineers. (*a*) Controller, 45–55, at least eight to ten years' experience with large manufacturing organization. (*b*) Executive assistant, at least five to ten years' experience in machine-shop practice and some previous administrative responsibilities. Salary, $10,000 and up. Conn. Y-6689.

Sales and Service Manager, at least five years' commercial experience covering gasoline and Diesel engines, pumps, portable generators compressors for equipment distributor. $6000–$7000. Queens, N. Y. Y-6695.

Product-Development Engineer, preferably with experience in small package goods, such as pen and pencil manufacture, or in small metal, or plastic consumer goods articles manufactured on mass-production basis. $8000–$12,000. New England. Y-6697.

Engineers. (*a*) Research engineer, graduate work in strength of materials and electronics. Considerable experience in laboratory testing and technique preferred. Should be able to conduct group meetings and have the ability through demonstrations and lectures to explain the fundamentals of various problems involved with particular stress being placed on the design of packing and shipping containers. Salary open. (*b*) Graduate engineer, mechanical, electrical, or civil, some industrial experience, preferably in the transportation field. Work involves preparation of specifications, conducting surveys, and studies of packing, shipping, materials handling, preparation of reports and publications given wide distribution. Considerable traveling in U. S. and Canada. Headquarters, Ill. Y-6699.

Mechanical Engineer, four or five years' experience in process industry, to estimate, procure material, design, lay out, and supervise new equipment installations. $6000–$7200. Northern N. Y. State. Y-6704(*b*).

Staff Engineer, graduate, considerable experience as member of engineering staff. Should have had position of responsibility in direction of engineering design, plant maintenance and construction, and field installation relative to chemical plants. Duties will require applicant to serve as liaison with engineering departments in dissemination of information, revisions, ideas, etc.; to establish and meet progress schedules; to assist in project planning; to initiate estimates and assume other assignments of an engineering nature. $7500 and up. Northern N. J. Y-6706(*b*).

Industrial Engineers, young, preferably graduates from Eastern schools, background in time and motion-study work or comparable MTM standards. Company specializes in the manufacture of current communication and control equipment. Calif. Y-6711.

Mechanical Engineer–Designer to take charge of squad of five or six men on steam-power-plant layout and design. $9000–$10,200. New York, N. Y. Y-6715.

Engineers. (*a*) Master mechanic, 30–40, college graduate, to be in charge of all trades. Will assist plant engineer and perform administrative functions. Prefer someone experienced in the maintenance of rubber machinery. Salary open. (*b*) Junior mechanical engineer, 25–30, to assume project assignments and be in complete charge of process and production-engineering investigations. Will also do some machine design and plant layout as required. Salary open. Ohio. Y-6726.

Engineers. (*b*) Engineering mathematician, 28–32, MS degree in physics, with strong background of applied mechanics. Ability to handle problems involving analysis and evaluation of data, various mathematical laws and equations. Limited travel. $8000. (*c*) Design layout engineers to 35, mechanical degree, five years' experience. Must be familiar with design of intricate mechanisms and electromechanical control work. Should have general electrical knowledge to back up mechanical experience. Possibly some traveling. $7800. (*d*) Electromechanical designers, 28–32, BS, five to ten years' experience. Ability to supervise group projects. Ability to work from the theoretical start, through final design, to production. Work on the board as well as follow through with work in the shop and laboratory. Able to design for mass production. $6500–$7800. N. Y. State. Y-6732.

Engineers. (*a*) Mechanical designers, BS or MS in electronics, with ability to work on liaison level with civilian and military personnel. Work includes data analysis and methods of dealing with photoelectric cells and oscillators, voltages, mechanical motion, and methods of conversion of such information to punch cards. Familiar with optics and general aircraft ordnance, for manufacturer of intricate electromechanical equipment. Considerable traveling. $6500–$7800. (*b*) Research physicist, to 35, MS or PhD degree, plus five to ten years' experience. Must have creative ability stemming from theoretical knowledge plus practical experience. Familiar with input measures, temperature measurements, altitude measurements, and sound knowledge of various phenomena with the ability to weigh one method against another and to determine or devise the method to be utilized. Some travel required. $8000–$10,000. (*c*) Mechanical engineer, 28–32, graduate, five to ten years' experience in applied mechanics. Must have strong experience in one or more of the following fields: gyroscopics, high-speed clutch mechanisms, servomechanism, optics, analog computors, storage tables. Willing to work on the board and follow through the shop. To $10,000. N. Y. State. Y-6733.

Engineers. (*a*) Designer-engineer, mechanical or electrical, experience in thermostat and switch fields, to take charge of design and development of bimetal thermostats and temperature-operated switches. $6000–$8000. (*b*) Sales engineer, mechanical or electrical, at least ten years' experience in the sale of thermal-operated switches and devices. $8000–$10,000. N. J. Metropolitan area. Y-6735.

Co-ordinator of Technical Services, mechanical graduate or equivalent in experience involving drafting room, mechanical and electrical shop practices, and about 12 to 15 years' responsible professional experience in supervising a drafting room and a machine shop. Minimum of ten years of this experience should have been as a designer and chief draftsman responsible for the operation of a drafting room. Will control and supervise the heads of the machine shop, drafting room, and instrument laboratory. $10,000. Company will pay employment fee. N. Y. Metropolitan area. Y-6744(*a*).

Engineers. (*a*) Product designers, mechanical graduates or equivalent in engineering experience and studies in advanced mathematics, machine design, materials and methods, and shop practice, about ten years' experience in the instrument and small, precise, mechanical-devices field as a designer and development engineer. Knowledge of optics and photography desired. Will take charge of the design of one or more projects; develop sound layout of internal mechanisms or system of original design or as evolved in discussions with the staff. $9100. (*b*) Chief production engineer, mechanical graduate, postgraduate studies in industrial engineering, including machine and methods, planning, controls, materials, etc.; minimum of 15 years' responsible experience involving design, development, and production of highly precise mechanical and electromechanical devices and instruments. Will be member of technical staff of engineering department and sponsor all electronic projects in engineering. Organize, assign, and supervise engineers involved from the preliminary analysis and study to the fulfillment of the project, or contract. $12,000. Company will pay fee. N. Y. Metropolitan area. Y-6746.

Mechanical Engineer to take charge of the design and supervision of mechanical features of multimillion-dollar projects. This will include heating, plumbing, air conditioning, and ventilation. Must be able to handle his department efficiently, meet and talk with clients, and have a sense of responsibility. $10,000–$12,000. Wash. State. Y-6748.

Mechanical Engineer, at least ten years' railroad experience in mechanical engineering, after completing standard apprenticeship, to prepare equipment specifications and supervise drawing-room force covering all types of rolling equipment, shop, and power plant machinery. $6900. N. J. Y-6764.

Production Engineer, 30–40, mechanical graduate, with supervisory manufacturing experience as production engineer, general foreman, or assistant plant superintendent, to assist plant manager in general manufacturing plant. $8000–$10,000. Northern N. Y. State. Y-6766.

(*ASME News continued on page 352*)

HERE IS YOUR BOILER WATER LEVEL

Yarway Floatless Hi-Lo Alarm Water Column with Vertical Pressure-Sealed Flat Glass Gage. Equipped with Type "M" Illuminator. For pressures to 2500 psi. See Bulletin WG-1811

YARWAY TYPE "M" ILLUMINATOR MAKES MENISCUS

Do you guess the level is normal . . . but perhaps because the gage glass is dirty, or the atmosphere hazy, you *aren't quite sure?*

Then you're the man we want to tell about the Yarway Type "M" Illuminator. It makes the boiler water level in your Yarway Flat Glass Gage instantly visible because the meniscus stands out like a *brilliant blue-white star.*

The Type "M" Illuminator is designed to give maximum brilliance, and spots the boiler water level over its entire traverse. The penetration of its blue-white light cuts through deposits on the gage glasses, extraneous light and dust particles in the air. Also it's effective over longer distances. New or installed Yarway Flat Glass Gages may be equipped with the illuminator. Can be installed in pairs on four-glass gages.

For specifications, prices, etc., call nearest Yarway office or write—

YARNALL-WARING COMPANY • 108 Mermaid Avenue, Philadelphia 18, Pa.
Branch Offices in Principal Cities

YARWAY

Candidates for Membership and Transfer in the ASME

THE application of each of the candidates listed below is to be voted on after April 25, 1952, provided no objection thereto is made before that date and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the secretary of The American Society of Mechanical Engineers immediately.

KEY TO ABBREVIATIONS

R = Re-election; Rt = Reinstatement; Rt & T = Reinstatement and Transfer to Member.

NEW APPLICATIONS

For Member, Associate, or Junior

ADDISON, JAMES C., Miami, Fla.
ADKINS, SELDEN K., Chicago, Ill.
ALVIS, JAMES F., Dallas, Texas
AMBROSIO, ALPHONSO, Los Angeles, Calif.
BAHM, FLETCHER H., Shreveport, La.
BARKSDALE, JOHN M., Chattanooga, Tenn.
BATAILLE, GERALD S., Wauconda, Ill.
BATES, SIDNEY E., Jr., Chicago, Ill.
BENN, ROBERT C., Upper Montclair, N. J.
BERNA, TELL, Cleveland, Ohio (Rt)
BILLINGSLEY, KENNETH, Alliance, Ohio
BLAGROVE, HARRY G., Media, Pa.
BROWN, ROBERT H., Fitchburg, Mass. (Rt)
CALDWALLADER, GOUVERNEUR, Solebury, Pa.
CARLSON, NORMAN E., New York, N. Y. (Rt & T)
CASANOVA, H., MAURICIO, Lansdowne, Pa.
CASGRAIN, CHARLES W., 2ND, Detroit, Mich.
CAULAND, ALFRED C., Jr., Los Angeles, Calif.
CHAPMAN, ELMER E., Kansas City, Kan.
CHOTKOWSKI, BOLESLAW, Fairfield, Conn.
CLAUS, WALTER B., Pasadena, Calif.
COCAYNE, ROBERT W., Kansas City, Mo.
D'ANSSERAU, JOSEPH X., Montreal, Que., Can.
DATZ, SEYMOUR, Cleveland, Ohio
DAVIS, FREDERICK A., Toronto, Ont., Can.
DENCER, FREDERICK A., Cincinnati, Ohio
DOWNEY, JULIAN B., Houston, Texas
EMBREE, JOHN M., Philadelphia, Pa.
FAIRLAMB, CHARLES R., Paterson, N. J.
FLACK, NEWTON D., Euclid, Ohio
GARY, JEROME A., Long Beach, Calif.
GILL, ROBERT A., Detroit, Mich.
GOLDBERG, ARNOLD, Chicago, Ill. (Rt & T)
GOWING, R. A., North Canton, Ohio.
GREIPP, ROBERT, Neponsit, L. I., N. Y.
GREYSON, JOSEPH C., Ardmore, Pa.
GRISWOLD, HAROLD H., Charlotte, N. C.
GURVARA, RENE O., Lima, Peru, S. A.
GUIDO, PAUL V., Bronx, N. Y.
HABER, CHARLES P., Pittsburgh, Pa.
HAGLEY, LEONARD T., Cleveland Heights, Ohio
HARNISH, RENO L., Jr., New Holland, Pa.
HAZELETT, RICHARD, Cleveland, Ohio
HECKMAN, O. E., Richmond Hill, L. I., N. Y.
HEMPE, HAROLD H., Wauwatosa, Wis.
HERRINGTON, JAMES W., Lancaster, S. C.
HETER, MARVIN W., Kansas City, Mo.
HEYTOW, ALLAN F., Chicago, Ill.
HOLSTEDT, RICHARD A., Chicago, Ill.
HUMPHREYS, THOMAS E., Brockton, Mass.
JACOBS, JOHN D., Franklin, Tenn.
JENSEN, NIELS H., Glen Moore, Pa.
JENSEN, ROBERT B., Drexel Hill, Pa.
JIAN, SOHAN SINGH, Fort Wayne, Ind.
JONELIS, ROBERT E., Chicago, Ill.
KALPOPULOS, A. F., Jamaica Plain, Mass.
KLOCK, ROBERT A., Huntington Woods, Mich.
KNIGHT, KENNETH T., Raleigh, N. C.
KOPLER, DOV J., Tel-Aviv, Israel
KRET, DAVID B., Chester, Pa.
LAMAR, CHARLES E., Arcadia, Calif.
LAY, JOHN W., Jr., Detroit, Mich.
LEVEE, H. H., Kew Gardens Hills, L. I., N. Y.
LUDDEN, FRANK C., Corpus Christi, Texas
LUDING, CALVIN E., Ilion, N. Y.
MACCARLEY, JOHN A., Burbank, Calif.
MARTINEZ, CELESTINO A., Clewiston, Fla.
MATTHEWS, JOHN F., North Andover, Mass.
MAYTHAM, FRANK, San Francisco, Calif.
MCCABE, HENRY J., Waterbury, Conn. (Rt & T)
MILLER, DONALD B., New York, N. Y.
MORRIS, ERNEST T., Richland, Wash.
NICHOLS, WILLIAM E., Augusta, Maine
NIMMER, FREDERICK W., Akron, Ohio
O'HIGGINS, P. J., Ruislip Manor, Middlesex, England
PACHT, MILTON W., New York, N. Y.
PERRYN, RICHARD M., Wilmington, Del.
RHOADES, EARLE D., Burlington, Iowa
RICH, BARRETT G., Waterloo, Iowa
RIGASSIO, JAMES L., North Bergen, N. J.
ROBISON, HENRY E., Boston, Mass.
ROOD, JESSE E., New York, N. Y.
ROSE, JOHN E., Toronto, Ont., Can.
ROSEN, MELVIN, Brooklyn, N. Y.
SIEWERTSEN, HANS A., Los Angeles, Calif.
SOBOLEWSKI, ADAM E., Lakewood, Ohio
SPOOR, LESLIE A., Collinsville, Ill.
STAUFFER, ROBERT N., Highland Park, Mich.
STEPHAN, EDWARD, Clifton, N. J.
STEVENS, JAMES E., Jr., Chattanooga, Tenn.
STEVENS, W. D., St. Clair Shores, Mich.
SUTTON, R. A., Tia Juana, Estado Zulia, Venezuela, S. A.
TAYLOR, WARREN S., New York, N. Y.
THOMPSON, PAUL, Aurora, Ill.
WALKER, HARRY A., Mexico, D. F., Mex.
WARNER, KENT F., Detroit, Mich.
WEIDHAAS, ERNEST R., New York, N. Y.
WESTCOTT, GEORGE E., Penns Grove, N. J.
WILLIAMS, W. O., Chicago, Ill.
WISKOPSKE, HARRY J., Massillon, Ohio
WRIGHT, WILLIAM F., Nashville, Tenn.

CHANGE IN GRADING

Transfers to Member and Associate

BARRETT, ROBERT D., Westchester, Ill.
CROYLE, HARRY A., New York, N. Y.
DAVISON, ROBERT E., Seattle, Wash.
DERBY, ROBERT E., Philadelphia, Pa.
ELLENBERGER, F. R., Bloomfield, N. J.
FEIN, MITCHELL, New York, N. Y.
GERSHON, MILTON, Bloomfield, N. J.
GOLDMAN, THOMAS D., Baltimore, Md.
GOLDSTEIN, IRVING R., Union, N. J.
HANKS, G. J., Jr., Charleston, W. Va.
HARPER, K. W., Orchard Park, N. Y.
JANOWITZ, ROBERT, Kansas City, Kan.
JONES, CLARENCE R., Jr., Augusta, Ga.
KIERNAN, BERNARD L., New Orleans, La.
LOW, SIDNEY, Indian Orchard, Mass.
MATHEISEL, RUDOLPH, Tilton, N. H.
MAY, JOHN P., Schenectady, N. Y.
MCKEE, ROBERT J., Fostoria, Ohio
POWELL, JOHN A., West Springfield, Mass.
POWELL, WILLIAM, Jr., Philadelphia, Pa.
RUSSELL, ROBERT A., Mission, Kan.
SHEPHERD, BURCHARD P., Wheatridge, Colo.
SIDEBOTTOM, OMAR M., Urbana, Ill.
SIMMONS, KENNETH A., Washington, D. C.
VALENTYNE, PETER H., Saginaw, Mich.
VANDER VOORT, D. G., Valleyfield, Que., Can.
WALIN, DON R., San Diego, Calif.

Transfers from Student Member to Junior....150

Obituaries

John Gladding Aldrich (1864–1952)

JOHN G. ALDRICH, president of New England Butt Co., industrialist, and artist, died Jan. 20, 1952, in Jane Brown Hospital, Providence, R. I. Born, Providence, R. I., Nov. 24, 1864. Parents, Elisha S. and Anna E. (Gladding) Aldrich. Education, BS, Worcester Polytechnic Institute, 1885. Married Margaret P. Calder, 1891. Mem. ASME, 1901. Survived by three sons, John G., Jr., Putnam C., and David; also a sister, Amey Aldrich, New York, N. Y.

James Monroe Brown (1873–1952)

JAMES M. BROWN, retired mechanical engineer, died Jan. 14, 1952. Born, Massilon, Ohio, Aug. 22, 1873. Parents, James E. and Isabelle (Hurathal) Brown. Education, 3 years, Williams College; BS, Massachusetts Institute of Technology, 1897. Married Mabel Mell, 1899. Jun. ASME, 1900; Mem. ASME, 1906. Survived by wife and two children, Louise B. Perry and James E., both of Mount Vernon, Ohio.

Gerald Miller Camp (1924–1951)

GERALD M. CAMP, Lieutenant, attached to Second Division, U. S. Army, was killed in action in Korea, May 17, 1951. Born, Lavoye, Wyo., Feb. 23, 1924. Education, BSME, Texas A&M College, 1948. Jun. ASME, 1948. Survived by wife and son, Gerald M., 2nd.

Harry Clarence Carroll (1880–1951)

HARRY C. CARROLL, head, mechanical-engineering department, Commercial Testing and Engineering Co., Chicago, Ill., died Dec. 25, 1951. Born, New Haven, Conn., Dec. 28, 1880. Parents, Clarence Franklin and Julia (Webster) Carroll. Education, ME, Cornell University, 1903. Married Valla Hope Wycoff, 1909. Mem. ASME, 1927. Survived by wife and three children, Mrs. Hope Knabe, Mrs. Julia Bair, and Harry C., Jr.

Daniel Edward Evans (1885–1951)

DANIEL E. EVANS, chairman, board of directors, and chief engineer, Evans Deakin and Co., Ltd., Brisbane, Queensland, Australia, died Dec. 1, 1951. Born, Geelong, Victoria, Australia, May 8, 1885. Education, graduate, Technical College, Queensland. Mem. ASME, 1933.

Roy William Finck (1924–1951)

ROY W. FINCK, Lieutenant, U. S. A. F., was killed in France, Nov. 13, 1951. Born, St. Charles, Mo., Feb. 9, 1924. Parents, Mr. and Mrs. Emil P. Finck. Education, BSME, University of Missouri, 1949. Jun. ASME, 1949. Survived by parents.

Alfred W. Fox (1904–1951)

ALFRED W. FOX, manager, energies and electrical-engineering departments, General Aniline Film Corp., Binghamton, N. Y., died Oct. 16, 1951. Born, New York, N. Y., Feb. 12, 1904. Parents, Julius H. and Margaret (Wines) Fox. Education, AB, Columbia University, 1925; BS, 1926; ME, 1927. Married Virginia M. FitzSimons; son, Richard C. Jun. ASME, 1937.

Benjamin Greenfield (1881–1952)

BENJAMIN GREENFIELD, retired electrical engineer, Cities Service Research and Development Co., Hillside, N. J., died at his home in Elizabeth, N. J., Jan. 2, 1952. Born, Sabetha, Kan., Aug. 9, 1881. Parents, James E. and Ida Carolin Greenfield. Education, BSEE, University of Wisconsin, 1907. Married Esther C. Holmes, 1914. Mem. ASME, 1918. Survived by wife, a sister, Myrtle Greenfield, Albuquerque, N. Mex.; and brother, Edmund R., Decatur, Ill.

Frank Joseph Gulshen (1925–1951)

FRANK J. GULSHEN, ensign, U. S. Navy (aviator), died May 22, 1951. Born, Kewanee, Ill., April 29, 1925. Parents, Frank Edward and Josephine G. Gulshen. Education, BSME, State University of Iowa, 1949. Jun. ASME, 1949. Survived by parents, a sister, Mrs. Robert DeOtte, Lamesa, Texas; and a brother, John T.

Harry Benton Hoshall (1885–1952)

HARRY B. HOSHALL, associate professor of mechanical engineering, University of Maryland, died Jan. 5, 1952. Born, Parkton, Md., Sept. 20, 1885. Parents, Joshua G. and Sarah Ellen Hoshall. Education, BS(ME), University of Maryland, 1908; ME, 1930. Mem. ASME, 1940.

Robert Joseph Kehl (1889–1951)

ROBERT J. KEHL, consulting engineer, Linde Air Products Co., New York, N. Y., died Nov. 23, 1951. Born, Chicago, Ill., Nov. 24, 1889. Parents, Robert E. and Ida M. (Ortmayer) Kehl. Education, ME, Cornell University, 1912. Married Amalie Lillig, 1928. Jun. ASME, 1915; Mem. ASME, 1923. Served as ASME Representative on ASA Standardization of Pressure and Vacuum Gages Committee. Survived by wife and two children, Roy E., and Joy Anna.

Harry Joseph Kelly (1890–1952)

HARRY J. KELLY, retired general manager, Construction and Maintenance Division, manufacturing department, Gulf Oil Corp., Pittsburgh, Pa., died Jan. 21, 1952. Born, Lafayette, Ind., Feb. 6, 1890. Parents, Harry J. and Josephine (Huse) Kelly. Education, BSCE, Texas A&M College, 1911. Married (predeceased by wife). Mem. ASME, 1923. Survived by son, John H.

Edwin Elliot Kimball (1880–1951)

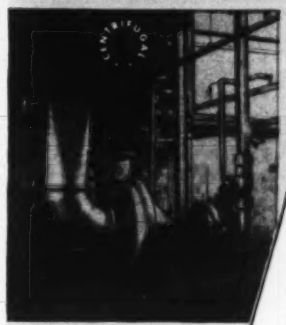
EDWIN E. KIMBALL, retired engineer, the General Electric Co., Schenectady, N. Y., died Dec. 26, 1951. Born, Salt Lake City, Utah, March 10, 1880. Parents, Edward and Genevieve (Hartwell) Kimball. Education, BSEE, Massachusetts Institute of Technology, 1902. Married Mrs. M. Maury Corbin, 1915. Mem. ASME, 1943. Survived by wife and two stepsons, S. Wellford Corbin, Mem. ASME; and James McH. Corbin.

Charles Burton King (1875–1951?)

CHARLES B. KING, whose death was recently reported to the Society, was retired vice-president and general manager, Marion (Ohio) Steam Shovel Co. Born, Marion, Ohio, Jan. 25, 1875. Parents, George T. and Margaret (Barnhart) King. Education 3 years, Ohio Wesleyan University. Married Ethel Liggett, 1899. Mem. ASME, 1912. His inventions include a number pertaining to excavating machinery; he designed first electrically driven steam shovel; was originator of designs for many laborsaving devices, which developed new fields of industry.

(*ASME News continued on page 354*)

BEFORE BUYING *any* BLOWER COMPARE THESE ESSENTIALS



Single-Stage, Type OIB Centrifugal Blower in food processing plant. Steam turbine drive. Capacity 12,000 cfm.

- ☐ Choice of Rotary or Centrifugal
- ☐ Capacity matched to the job
- ☐ Easy accessibility
- ☐ Ruggedness
- ☐ Ease of installation
- ☐ Ability to handle overloads
- ☐ Long-time durability
- ☐ Freedom from breakdowns
- ☐ Low maintenance costs
- ☐ Engineering assistance
- ☐ Proved reputation of maker
- ☐ Customer satisfaction

When production depends so vitally on adequate handling of gas or air, you can't afford to take chances on the performance of your blowers or exhausters. It's better to be safe than sorry.

So, for new installations or replacements, we suggest that you evaluate the equipment by the above standards of comparison. This will help determine the unit that will be most effective, economical and reliable for your specific applications.

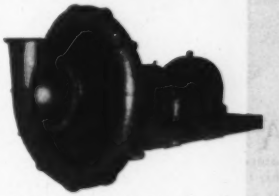
Be sure to include the R-C *dual-ability* line of both Centrifugal and Rotary Positive types. Remember that only we offer you this *dual choice*—with unbiased recommendations from almost a century of experience. With capacities from 10 cfm to 100,000 cfm or higher at moderate pressures, R-C equipment has a long record of outstanding performance in industrial applications.

We'll gladly send detailed information for comparison—or supply engineering help if we can be of service.

ROOTS-CONNERSVILLE BLOWER CORPORATION
521 Michigan, Connersville, Indiana

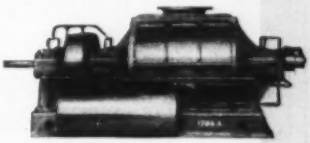
THE *DUAL-ABILITY* LINE OF MODERN EQUIPMENT TO HANDLE GAS AND AIR

Multi-Stage Centrifugal Exhausters



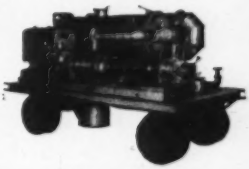
Single-Stage Centrifugal Blowers

Rotary Positive Blowers



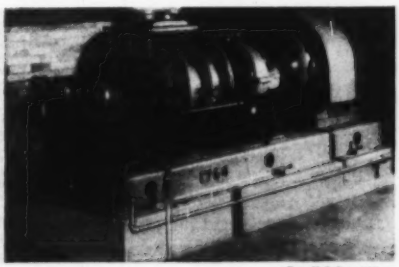
Rotary Positive Gas Pumps

Positive Displacement Meters



Inert Gas Generators

ROTARY



Type RCDH Blower in electric power plant, with capacity of 3,380 cfm.

Reg. U.S. Pat. Office

ROOTS-CONNERSVILLE

BLOWER BUILDERS SINCE 1854

ONE OF THE DRESSER INDUSTRIES

Harry Anderson Knowlton (1925–1951)

HARRY A. KNOWLTON, metallurgical engineer, Wisconsin Steel Works, International Harvester Co., Chicago, Ill., died Aug. 31, 1951. Born, Milwaukee, Wis., June 4, 1925. Parents, Harry B. and Jane Knowlton. Education, BS(ME), Illinois Institute of Technology, 1946; MS (Met. E) Carnegie Institute of Technology, 1945. Married Verna Lindgren, 1951. Jun. ASME, 1947. Survived by wife, his parents, and a brother, William J.

Michael Joseph McKew (1892–1951)

MICHAEL J. MCKEW, director and works manager, Evans Deakin and Co., Ltd., Brisbane, Queensland, Australia, died Dec. 18, 1951. Born, Wolston, Queensland, Australia, Feb. 16, 1892. Education, Central Technical College, Brisbane, 1908–1915. Mem. ASME, 1948.

Edward Thomas Murphy (1880–1951)

EDWARD T. MURPHY, senior vice-president and member of the board of directors, Carrier Corp., Syracuse, N. Y., died Aug. 21, 1951, in San Francisco, Calif. Born, New York, N. Y., June 6, 1880. Parents, Timothy E. and Sarah (Banghardt) Murphy. Education, ME, Lehigh University, 1901. Married Doris R. Duncan, 1929. Inventor of humidity control and moisture-content control for blast furnaces. Jun. ASME, 1905; Mem. ASME, 1917. Survived by wife.

William Henry Oldacre (1892–1952)

WILLIAM H. OLDACRE, president and general manager, D. A. Stuart Oil Co., Chicago, Ill., died Jan. 18, 1952. Born, Warren, Ohio, April 7, 1892. Parents, Harry D. and Jane (Jones) Oldacre. Education, BA, Hiram College, 1914. Married Florence H. Harsh, 1917; children, Kathryn J. (Mrs. J. Wendell) George, William J., Jr. (deceased). Mem. ASME, 1936. At the time of his death he was serving the Society as chairman of the General Committee, 1952 Fall Meeting to be held in Chicago, Ill., Sept. 8–11, 1952; member, Medals Committee. In 1949 and 1950 he was chairman of the Nominating Committee; chairman, Chicago Section, 1948–1949. He also served on the Research Committee on Cutting Fluids since 1934; the Subcommittee on Threading of the Research Committee on Cutting Fluids, from 1946; and the Research Committee on Metal Cutting Data and Bibliography, since December 1943. He wrote many papers on cutting fluids and metalworking problems.

Joseph Anton Pellettere (1901–1952)

JOSEPH A. PELLETTERE, chief instrument engineer, engineering department, Gulf Oil Corp., Pittsburgh, Pa., died Jan. 14, 1952. Born, Houston, Texas, Nov. 8, 1901. Parents, Anton and Mary (Provenzano) Pellettere. Education, BS (ChE), Rice Institute, 1922. Married Rose Colicher, 1924. Mem. ASME, 1948. He wrote several papers on instrumentation engineering and process-control instruments. Survived by wife and two daughters, Dolores and Mrs. Rose Marie Schafer; and two sisters, Mrs. Agnes Mason and Mrs. Effie Matranga, both of Houston.

Fenton Dowling Rahm (1889–1952)

FENTON D. RAHM, assistant to vice-president, sales engineer, and manager, Houston, Texas, office, A. M. Lockett and Co., Ltd., died Jan. 11, 1952. Born, New Orleans, La., Feb. 28, 1889. Parents, Phillip A. and Mary (Dowling) Rahm. Education, high-school graduate; special courses, Tulane University. Married Tennie Butler Scott, 1926. Assoc. ASME, 1923. Survived by wife; stepson, Vernon B. Scott; and two grandchildren.

Lewis Ellis Saxby (1889–1951)

LEWIS E. SAXBY, electrical designer-engineer, died July 30, 1951, at Community Hospital, Montclair, N. J. Born, Chicago, Ill., June 23, 1889. Parents, Lewis and Florence (Ellis) Saxby. Education, ME, Stevens Institute of Technology, 1915. Married Elizabeth McCormick, 1923. Jun. ASME, 1917; Mem. ASME, 1921. Survived by wife and daughter, Elizabeth L.

Clarence Eugene Smith (1923–1951)

CLARENCE E. SMITH, lubrication engineer, Wofford Oil Co., Atlanta, Ga., died Dec. 14, 1951. Born, Monticello, Ga., Nov. 30, 1923. Parents, James Roy and Lucy (Sigman) Smith. Education, BME, Georgia Institute of Technology, 1949. Married Emma Jane Agnew, 1945. He received the Air Medal with five oakleaf clusters. Jun. ASME, 1949. Survived by wife and three children, Clarence E., Jr., James Paul, Emma Corine; his mother; and two brothers and two sisters.

William Stanley Tawes (1923–1951)

WILLIAM S. TAWES, Lieutenant, 77th Field Artillery, 1st Cavalry Division, U. S. Army, was killed in action Oct. 4, 1951, in Korea. Born, Townsend, Del., May 4, 1923. Parents, William Isaac and Virginia Ruth Tawes. Education, BME, University of Delaware, 1950. Married Lucille Dietrich, 1949. Jun. ASME, 1950. Survived by wife and son, Walter Richard, 2nd; his father; and brother, Robert H.

Clarence Gilbert Vandegrift (1907–1951)

CLARENCE G. VANDEGRIFT, associate professor of mechanical engineering, the Pennsylvania State College, died Nov. 10, 1951. Born, Ridgeley, W. Va., Jan. 6, 1907. Parents, Mr. and Mrs. James Thomas Vandegrift. Education, BS, West Virginia University, 1929; MS, Pennsylvania State College, 1937. Married Katherine Garland, 1929. Jun. ASME, 1930; Mem. ASME, 1946. Survived by wife.

James Van Rensselaer Willett (1894–1951?)

JAMES V. WILLETT, whose death was recently reported to the Society, was chief draftsman, Universal Oil Products Co., Chicago, Ill. Born, Buffalo, N. Y., July 25, 1894. Education, BS (ME), Illinois (Armour) Institute of Technology, 1916. Mem. ASME, 1951.

H. Comer Wolf (1888–1951)

H. COMER WOLF, consulting engineer, Minera Product Corp., Rockford, Ala., died Oct. 28, 1951, at Sylacauga, Ala. Born, Indianapolis, Ind., Dec. 20, 1888. Parents, Walter W. and Minnie H. (Comer) Wolf. Education, attended Purdue University; field service school, U. S. Army; postgraduate study at Oklahoma A&M College and Columbia University. Married B. May Sawyer, 1920; son, Comer D. Mem. ASME, 1948. He held several U. S. Patents on special research processing of rock asphalt, iron pyrite, and the like.

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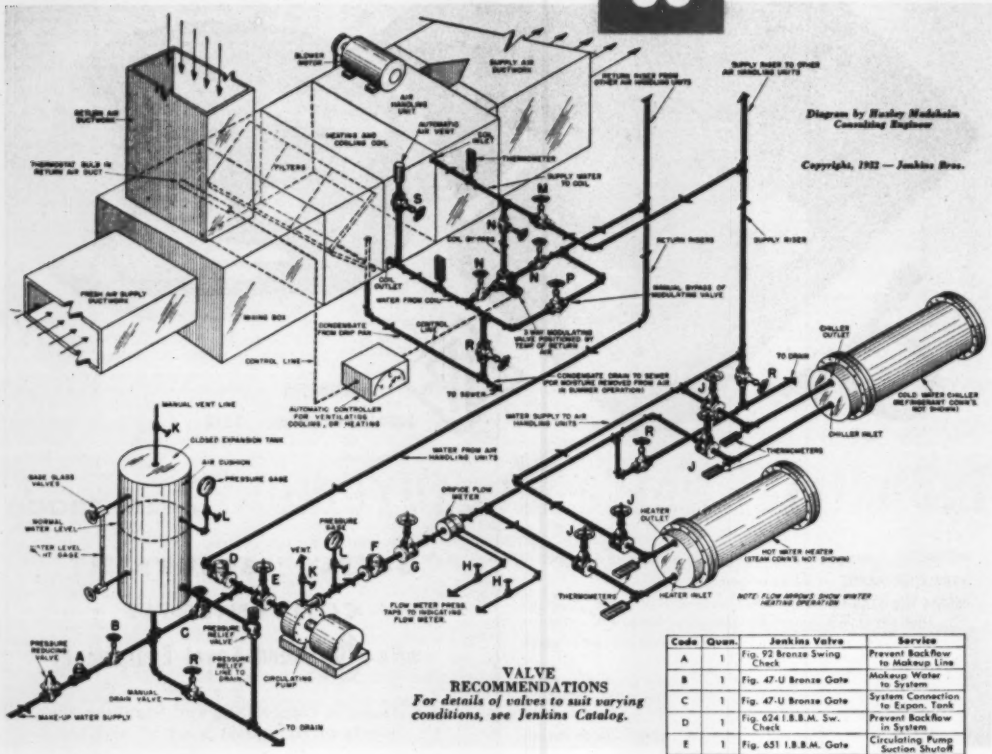

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C	1	Fig. 47-U Bronze Gate	System Connection to Expan. Tank
D	1	Fig. 624 I.B.B.M. Sw. Check	Prevent Backflow in System
E	1	Fig. 651 I.B.B.M. Gate	Circulating Pump Suction Shutoff
F	1	Fig. 624 I.B.B.M. Sw. Check	Prevent Backflow in System
G	1	Fig. 142 I.B.B.M. Globe	Regulate System Flow
H	2	Fig. 743-G Bronze Needle	Orifice Flowmeter Tap Connections
J	4	Fig. 651 I.B.B.M. Gate	Chiller and Heater Shutoffs
K	2	Fig. 743-G Bronze Needle	Vent Controls
L	2	Fig. 743-G Bronze Needle	Pressure Gage Controls
M	1	Fig. 106-A Bronze Globe	Flow Control to Individual Coils
N	3	Fig. 47-U Bronze Gate	Modulating Valve Shutoff
P	1	Fig. 106-A Bronze Globe	Modulating Valve Manual Bypass
R	4	Fig. 106-A Bronze Globe	Drain Valves
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4-52

NOT GOOD IF MAILED AFTER MAY 15, 1952

(Foreign Requests may be Mailed up to May 24, 1952)

CATALOG GUIDE

1 METAL BENDING

O'Neil-Irwin Mfg. Co.—New 32-page bending manual contains information on a wide variety of forming operations. The bending of tubing, angle, channel, extrusions as well as solid materials is graphically illustrated. Detailed prints show the exact manner in which any rotary-type bending machine can be tooled for precision bending. The manual outlines the recommended steps in designing parts to be formed, choice of materials, and selection of bending equipment.

2 THERMAL LIQUID HEATERS

International Boiler Works Co.—Catalog and Specification sheet describe International-LaMont thermal liquid heaters type LCF and Dowtherm vaporizers, Type LCD. For process temperatures to 750 F in the Chemical and Process industries. Units are completely packaged including oil or gas burner, forced recirculation pump, induced-draft fan, and all controls. Built in standard sizes from 250,000 to 2 million btu per hr. Also available in a series of larger units designated as type LFS with capacities to 10 million btu per hr. See performance data in 1952 ASME Catalog and Directory, page 188.

3 DROP FORGINGS

Drop Forging Association—"Metal Quality—Hot Working Improves the Properties of Metal," a 64-page booklet recently revised and issued by the Technical Committee, Drop Forging Association, for design engineers, metallurgists, and production-management executives, explains how hot-working improves metal quality. The text describes forging-quality steel and details of the various methods of forging. Check lists of the advantages obtained by use of forgings, economic benefits, are included.

4 ANACONDA COPPER AND COPPER ALLOYS

American Brass Co.—New edition of Anaconda Data Book contains 138 pages of tabulated weights and standard dimensions of copper and brass mill products, as well as compositions, physical constants, and properties of copper alloys. Miscellaneous data tables include conversions, comparisons of standard gages, capacities of tanks, dimensions of circles and squares, and mathematical rules and formulas.

5 GRINDING BULLETINS

Carborundum Co.—New revised series of Carborundum "Grinding Bulletins" are available. These have proved extremely popular in the past and because of expanding labor requirements of the current defense period such a revision and new distribution is now desirable. In addition, eight of these bulletins are entirely new, making a total of 32 bulletins in the series. Request Form A-1204 for entire series.

6 AXIAL-FLOW BLOWERS

Blower-Stoker Div.—Read Standard Corp.—Publication No. 88 gives dimensional, capacity, and other engineering data on Standardaire low, medium, and high capacity blowers. Includes isometric drawing showing location of all blower accessories, also suggested applications and typical users.

7 ELECTRONIC ANALOG COMPUTATION

George A. Philbrick Researches—Catalog and manual on GAP/R high-speed all-electronic analog computation describes line of components from which computors for many purposes may quickly be assembled; shows applications to study and design of dynamic structures and such control systems as industrial regulators and servomechanisms; presents philosophy and mathematical techniques for most effective usage.

8 WEIGHING MACHINES

Merrick Scale Mfg. Co.—Bulletin 851, describes automatic equipment for use in weighing materials in transit, carried on belt conveyers, and allied equipment to weigh and feed bulk materials by weight and predetermined rates. Many applications and examples of the more complex weighing setups are shown.

9 BOILER VALVES

Everlasting Valve Co.—A new bulletin No. E125 on valves for boiler services, such as surface blow, bottom blow-off, water column blow-off and connections, describes the Everlasting quick-opening and slow-opening straightway valves, angle valves, "Y" valves, and duplex blow-off Units, with complete specifications, materials of construction, and dimensions of each type. Illustrations include details of design, sectional and "exploded" views, and explanations of operation of the valves.

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BENDING MANUAL
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This instructive and authoritative booklet will quickly prove itself indispensable wherever bending is done or is needed. It brings you a veritable gold mine of tested, authentic bending methods applicable to any rotary type bender. The proper bending technique may frequently offer a new approach to an old problem by simplifying product design and cutting production costs.
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10 STEEL AND ALLOY PLATE FABRICATION

Nooter Corp.—Catalog lists the many specialized techniques and services of Nooter in the fabrication of tanks and vessels for the petroleum and chemical processing industries. Corrosion data charts provide valuable information on resistance values of commonly used metals with reference to hundreds of chemicals.

11 OVERHEAD HANDLING EQUIPMENT

American Monorail Co.—Bulletin C-1 covers uses of overhead materials-handling equipment and the advantages of overhead handling in many industries such as the aircraft and automobile fields, bulk materials handling, use in ceramic plants, chemical handling, foundry applications, machine shop uses, etc.

12 GRATING—FLOORING, SAFETY TREADS

Irving Subway Grating Co.—Catalog No. F-225 contains illustrations, descriptions, and engineering data on fireproof, durable, safe, clean, and economical gratings and safety steps (riveted, pressure-locked, and welded) for industrial plants, power plants, refineries, ships, railroad freight and passenger cars, and locomotives, open steel-mesh bridge decking, etc.

13 CONSTANT DELIVERY PUMPS

Oilgear Co.—4-page bulletin No. 46601 illustrates and describes three new constant delivery axial piston pumps for pressures up to 3000 and 5000 psi. These units incorporate balanced flat valves (port plates), simple one-piece rolling pistons, and reverse-flow high-pressure and supercharging pressure relief valves.

14 MAGNETIC SEPARATORS

Eriez Mfg. Co.—Various applications of Eriez non-electric permanent magnetic separators are described in the following bulletins: No. 15, nonelectric permanent magnetic separators for tramp iron removal; No. 553-A, the ferrous filter; No. 554, micromagnetic separator; No. 702, magnetic bump nonelectric permanently magnetized; No. 501-A, nonelectric permanent magnetic pulley.

15 PUMPS

American-Marsh Pumps, Inc.—Boiler Feed and General Service Pump Bulletin No. 381 describes and pictures this ball bearing, horizontally-split case, two-stage, single-suction centrifugal pumping unit. Shows electric motor and steam-turbine-driven models, 12 important features in large cross-section, specifications, general dimensions, meta-specifications, and modifications.

16 BRIDGE CRANES

Shepard Niles Crane and Hoist Corp.—Bulletin Nos. 179–180 illustrate and describe floor and cab-controlled electric traveling cranes in capacities from 1 to 450 tons. Grab bucket, gantry-wall, or jib cranes installations actually shown. If interested in cab controlled monorail hoists, request bulletin No. 177. These pictorial Bulletins actually show what has been done and what can be accomplished in cost reduction by employing proper material handling.

17 PLASTIC GEARS

Westinghouse Electric Corp.—MICARTA phenolic laminate gear material for silent gear operation. 30-times greater tooth deflection than steel. Sixteen-page book No. B4661 complete with design tables and formulas along with application and machining information.

18 WARREN-QUIMBY SCREW AND ROTEX PUMPS

Warren Steam Pump Co.—Bulletins S204 and WQ-50 illustrate and describe these two distinctly different types of rotary pumps, both built with internal and exterior gears, horizontal or vertical mounting, and in a variety of metals. Screw-pump capacities to 3000 gpm and Rotex to 100 gpm.

19 STROBOSCOPES

General Radio Co.—New folder describes complete line of electronic stroboscopes. An explanation is given of how the stroboscope works, and specific applications are shown for the different models. Detailed specifications and prices are included.

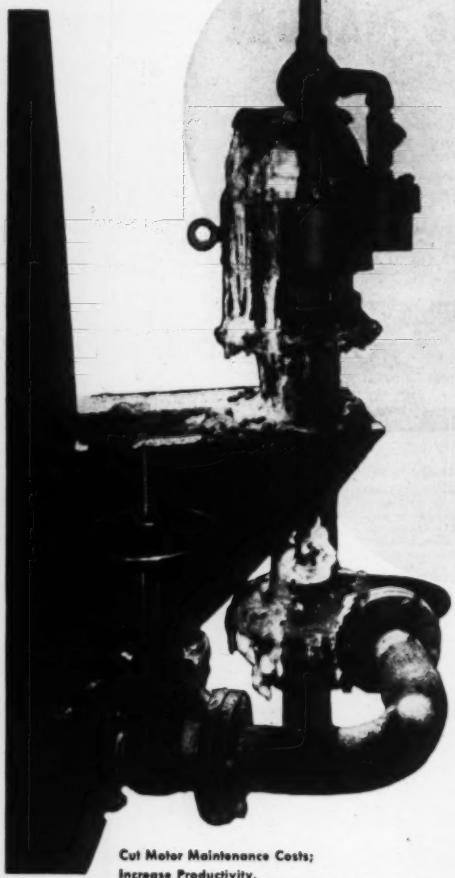
20 COPPER AND COPPER-ALLOY FORGINGS

American Brass Co.—A revised edition of its handy reference booklet on copper and copper-alloy die pressed forgings, is available. The 12-page booklet provides practical, to-the-point, comparative illustrations to show what die pressed forgings are, what they can do, what they have already done, what a manufacturer can expect of them. Tabulation of physical properties of copper and copper alloys suitable for forgings is included.

Continued on Page 4

DOW CORNING SILICONES

Give Standard Motors More Stamina



They saved $2100 and got greater overload capacity by rewinding with Class H insulation

Increased production schedules made it necessary to get 50% more pumping capacity out of a line of 22 mixing pumps. Exposed to outdoor weathering and to a variety of soluble salts, these pump motors rated at 2 h.p. were already taking all the punishment they could stand. Estimated cost of new 3 h.p. motors, plus installation of new mounts and brackets was $4400. Rewinding the old motors with Dow Corning (Class H) insulation, plus re-installation on the original mounts came to only $2300. That's a saving of $2100, plus a bonus of greater overload capacity and better chemical resistance.

The fact that Class H insulation has been used so successfully to up-rate motors proves that Dow Corning Silicones give standard motors more stamina. That means you can eliminate most of your repeated motor failures by specifying Class H insulation. That includes failures due to high ambient temperatures as well as high operating temperatures caused by overloads, high starting loads or rapidly reversing service; failures due to a combination of heat and excessive moisture or corrosive atmospheres. Pump motors, fan and blower motors, motors driving centrifuges or crane hoists, traction motors and motors in reversing service can be given as much as 50% more overload capacity. Life expectancy of Class H insulation made with Dow Corning Silicones is in the range of 4 to 100 times the life of Class B insulated equipment under comparable operating conditions. And Class H costs very little more than the second best class of insulation.

Cut Motor Maintenance Costs; Increase Productivity.

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21 OIL BURNERS

Engineer Co.—Bulletin OB-PC describes wide range mechanical or steam-atomizing-type oil atomizers for all types of pulverized coal; gas or oil-burning air registers; and fuel-oil pumping and heating-unit systems.

22 TURBO-COMPRESSOR

Spencer Turbine Co.—Bulletin 126A gives complete information on the Spencer Turbo-Compressors which have volumes from 85 to 20,000 cfm with pressures from 4 oz to 5 lb. Construction of the fans give a uniform pressure at varying volumes throughout their operating ranges. Cross-sectional drawings illustrate the simplicity of construction which keeps maintenance and repairs to a minimum. Besides showing Turbo information, many different applications are displayed showing constant air pressure in use.

23 CENTRIFUGAL PUMPS

Goulds Pumps, Inc.—Bulletin 710.1 describes centrifugal pumps available in 20 sizes with capacities up to 2000 gpm and heads up to 400 ft. The models are single stage, enclosed impeller type. Standardization of parts has been accomplished to the point where many wearing parts for one size are also used in several other units.

24 COMPRESSOR VALVES, PLATES, DISKS

J. H. H. Voss Co., Inc.—Literature describes Voss valves and Voss plates and disks which are applicable to any make, size, and type of air, ammonia, or gas compressors, including all the different refrigerating media; air, hydrogen, oxygen, gas, and corrosive media in vacuum-pump application. Available to manufacturers of new machinery as well as to users for replacements. Voss valves and valve plates are designed for each individual job and made on special machinery from the alloy or stainless steel best suited to the conditions under which they are to operate.

25 WEIGHING MACHINES

Toledo Scale Co.—This 42-page catalog gives full information on all types of Toledo scales for industrial weighing, testing, counting, balancing, classifying, and force measuring. Fully illustrated, including installation photos showing the scales in actual use. Special emphasis is given printed weights that eliminate human errors.

26 REVOLVING UNIT HEATERS

L. J. Wing Mfg. Co.—Bulletin HR-6 is the latest revised edition of a 16-page bulletin, illustrated with many new photographs of installations. Describes and illustrates ceiling-suspended, downward discharge unit heaters with revolving discharge outlets that distribute the heated air in slowly moving streams that reach into far corners, around machinery and obstructions, avoiding hot blasts and cold spots, and giving sensation of fresh, live, invigorating warmth to workers. Engineering data and installation details.

27 PIPE AND EXPANSION DATA

Ric-wil Co.—Section 480-6, a new pipe data flexibility brochure—58 pages devoted to the proper selection of pipe materials for any given installation or set of conditions and the inherent advantages of Ric-wil welded piping systems for underground or overhead insulated lines. Complete with abstracts of piping codes, also charts and tables for computing expansion, forces, and stresses in pipe lines.

28 COPPER AND COPPER ALLOYS

Revere Copper and Brass, Inc.—Booklet contains complete technical data on all leading Revere alloys. It includes material on coppers, brasses, bronze alloys, nickel alloys, manufactured forms, aluminum products, welded steel tube, lockseam tube, welding techniques, and a condensed list of products.

29 SHOP CARTS

Standard Pressed Steel Co.—Bulletin 797-1 describes the Hallowell "740" Stock Cart which has two deep trays, "double-angle" legs for strength, rubber tread, ball-bearing casters, detachable handle. The "740" boasts big capacity, compact design, and low price. Comes knocked down. Available in two sizes (trays—16 × 30 in. and 24 × 36 in.). Height 32 in.

30 DRAWING PENCIL

Eagle Pencil Co.—Sample of new improved Turquoise drawing pencil made with 100 per cent electronic graphite is offered. Laboratory tests show it to be smoother, longer-wearing, blacker, more opaque, and capable of holding a fine needle point without crumbling. Specify degree desired.

31 OIL COOLERS

Andale Co.—Bulletin 385-E (12 pages). Tested performances of 18 oil coolers (water cooled) tabulated to facilitate their selection economically for application to specific cooling problems. Tabulations under oil of 3 different oil viscosity characteristics and under each 3 water temperatures and under each water temperature numerous cooling ranges and elevations at which cooling is performed.

32 METALWORKING PUNCHES AND DIES

T. H. Lewthwaite Machine Co.—Notebook size catalog sheets listing in an easy-to-locate arrangement the wide range of metalworking punches and dies carried in stock for immediate shipment. Styles to fit most makes of hand, foot, and power-operated punch presses are standard. Hand-operated punches, cutters, and benders are also illustrated and described.

Read the various items listed . . . one catalog may hold the solution to your present problem . . . select those items of interest to you by number . . . fill in coupon on page 42 and mail promptly.

33 OIL FILTERS, STRAINERS, OILING DEVICES

Wm. W. Nugent & Co., Inc.—Seven bulletins: No. 6 illustrates and describes Nugent pressure strainers; No. 7, gravity filters; No. 7A, pressure filters; No. 8, tanks, pumps, shaft oilers; No. 14, oiling and filtering systems for turbines, paper mills, steel mills, pumps, compressors; No. 15, oiling devices; No. 16, sight feed valves, multiple oilers, flow indicators, sight overflows, and compression union fittings.

34 RELIEF VALVES

Crosby Steam Gage & Valve Co.—Catalog No. 300. Crosby-Ashton introduces a new simplified system of relief-valve-style nomenclature. Multicolored charts make valve selection easy. Pressures have been greatly expanded and aligned with ASA ratings for steel flanges. Many new valves have been added to round out the line. A section of useful engineering data is also included.

35 AUTOMATIC CONVEYER WEIGHING

Merrick Scale Mfg. Co.—For automatic and continuous weighing on existing or new belt conveyers, bulletin No. 375 fully illustrates and describes the Weightometer. The Merrick Feedoweight for blending and proportioning material by weight is also available.

36 D-C ARC WELDER

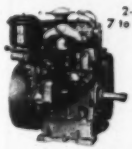
Westinghouse Electric Corp.—Bulletin No. B-5453 brings you up-to-date on Type RA developments. Gives complete performance and feature information and types of mountings available. Sections have been included on dual units, Heliarc Torch welding, duplex welders, stud welding and control attachments, both Arc-Drive and Remote.

37 FINTUBES

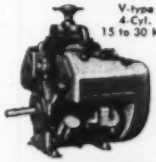
Brown Fintube Co.—Latest data on construction, application, and engineering of Brown Integral "one-piece" Fintubes, is given in a new bulletin, including comparisons of external surface of bare pipe or tubing with longitudinally finned pipe or tubing.

Power... To Fit the Job and the Machine

Single Cyl. 3 to 9 hp.



2-Cyl. 7 to 13 hp.



V-type 4-Cyl. 15 to 30 hp.

WISCONSIN Heavy-Duty Air-Cooled ENGINES

Today, leading manufacturers of agricultural machines, construction and oil field equipment, railway maintenance equipment for both on-track and off-track operations, and many types of industrial machines employed in outdoor field service now specify Wisconsin Air-Cooled Engines as standard or optional power components . . . integrally mounted on their machines.

This broad acceptance may be credited to the fact that Wisconsin Air-Cooled Engines, because of their extreme compactness, light weight, economical operation and heavy-duty dependability . . . ideally fit both the machines and their service requirements.

Wisconsin Air-Cooled Engines are supplied in a complete power range, from 3 to 30 hp., in 4-cycle single cylinder, two-cylinder and V-type 4-cylinder models. We will be happy to put you in touch with the nearest Wisconsin Engine distributor and supply you with descriptive and engineering data. Your inquiry is invited.

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World's Largest Builders of Heavy-Duty Air-Cooled Engines
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38 ROTARY PRESSURE JOINTS

Seamlex Co., Inc.—New Bulletin 5000 describes "Seamlex" rotary joints with triple protection against leakage. Principal features: External screw adjustment to compensate for wear of seal without removal of joint; floating rotary seal balances misalignments; pressure-equalizing chamber prevents excessive wear of rotary seal. Conveys liquids and gases. Made in syphon and through-flow type. Pipe sizes $\frac{1}{2}$ to $1\frac{1}{4}$ in.

39 SPRAYING NOZZLES

Spraying Systems Co.—30-page catalog No. 22 lists hundreds of nozzles in tabular form to exactly meet requirements for aerating, air conditioning, chemical and metal processing, water cooling, aggregate washing, spray drying, descaling, cooling towers, condensers, spray ponds, etc. Gives spray characteristics, construction, materials, liquids sprayed, impact, use recommendations, sizes, pressures, capacities, and dimensions.

40 TOOL STEEL HANDBOOK

Allegheny Ludlum Steel Corp.—Complete information on properties, applications, and available forms of A-L tool steels in a handsome 196-page case-bound book. Also included: extensive discussion of heat-treating and handling techniques, complete set of weight tables and other useful reference material.

41 SELF-CONTAINED BOILERS

Cleaver-Brooks Co.—New boiler catalog No. AD-100 completely describes the self-contained LR boilers for heating and processing. Lists features, shows typical applications, covers design, construction, efficiency, and contains charts on capacities and dimensions. The back cover is devoted to engineering service and a complete list of sales representatives handling and servicing Cleaver-Brooks self-contained boilers.

Have You The Latest Data on Electric vs. Fuel-Fired Heating For Industrial Processing?

If you are interested in high heat transfer rates (8,500 B.T.U./hr./sq. ft. or less) or production line heating below 650°F.—investigate PAN-L-HEAT. Never before: so much heat—so quickly responsive—so accurately controlled—so effectively useful—for so many applications—at so little cost!

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JUST OFF THE PRESS—it shows and tells in charts, photos, and drawings how PAN-L-HEAT is more than likely the answer to many of your process heating problems. Write on your company letterhead for the complete story on

PAN-L-HEAT

42 SOOT BLOWERS

Vulcan Soot Blower Div.—Continental Foundry & Machine Co.—New bulletin No. 493 offers in condensed form, pertinent data on modern automatic-sequential soot blowing systems, including control panels and descriptions of air or electrically operated rotary long and short retractable units and manually operated units. Many construction details are shown and a complete list of representatives for U.S.A. and Canada is included.

43 COLD ROLL FORMING

Yoder Co.—Equipment and process of cold roll forming; end uses of its products, advantages, and commercial possibilities. Also auxiliary equipment for curving, coiling, ring-forming, making tubular shapes, perforating, welding, embossing, and other operations which can be incorporated in a continuous high-speed cold-forming production line. 88 pages of descriptions and illustrations.

44 BROACHING MACHINES, PRESSES

Oilgear Co.—Bulletin No. 10052A, contains complete specifications and condensed information on their standard line of Fluid Power Broaching Machines and Presses, illustrates and describes diversified special machines, and lists the fluid power components manufactured for direct and resale purposes.

45 AUTOMATIC SCALES

Richardson Scale Co.—Bulletin No. 0450 presents basic specifications of conventional Richardson automatic scales for materials-handling-by-weight. Over 200 materials (liquid and solid) are listed alphabetically, with information on the Richardson scale recommended for standard industrial applications.

46 FLEXIBLE SHAFT COUPLINGS

Poole Foundry & Machine Co.—Catalog 52 fully describes various types and sizes of flexible shaft couplings including medium duty, standard, mill motor, disengaging, vertical, and other special types.

47 CORROSION RESISTANCE OF COPPER AND COPPER ALLOYS

American Brass Co.—The results of studies of the nature of corrosive attack on copper and copper alloys have been published in a 24-page booklet, No. B-36, "Corrosion Resistance of Copper and Copper Alloys." The chemical and physical nature of corrosive attack in its various forms is explained. Included is a tabulation indicating the relative corrosion resistance of the principal types of copper and copper-base alloys when in contact with 183 different corroding agents.

48 PNEUMATIC AIR HOIST

Detroit Hoist & Machine Co.—Bulletin 708 features a pneumatic hoist with worm drive and air-powered, rotary type motor. No pistons or reciprocating parts are employed. Air flow, continuous and pulseless, provides exceptionally smooth operation. A sensitive, self-closing control permits a hoisting speed range of "crawl" to full speed.

49 ELECTRICAL MACHINERY

Fairbanks, Morse & Co.—Bulletin E100H, "Catechism of Electrical Machinery," presents the most important theoretical and practical features of common types of direct-current and alternating-current motors, generators, and control equipment. Intended for those who are not familiar with electrical phenomena or terminology. The text is illustrated with Fairbanks-Morse machinery, and in some cases the details of these machines are discussed.

50 CELLULAR RUBBER

Sponge Rubber Products Co.—New title, "Properties of, and Test Data on Cellular Rubber" explains 20-page content of technical work on open cellular structure rubber; hard and soft closed cellular structure rubber; and silicone compounds of each. Companion piece describes application made of various types.

51 BLAST CLEANING AND DUST CONTROL

Pangborn Corp.—The latest developments in blast cleaning or dust control in Bulletin 1200 Pangborn's "Condensed Catalog." This illustrated bulletin tells the full story of air and airless blast cleaning, hydro-sand blast, hydro-finish, wet sand blast, accessories, and dust control.

52 GEAR DRIVES

Western Gear Works—Bulletin 5204 describes the Pacific-Western line of gear drives which covers a large range of horsepower and ratios with standard high-speed units ranging to 1700 hp and standard speed-reducing units up to 10,000 hp. This catalog

covers both types of units suitable for pipe-line pumping operations which require a step-up or reduction of speed between the prime mover and the driven element.

53 BALL BEARINGS

New Departure, Div., of General Motors—Supplementing its standard catalog, a series of five books, helpful to the engineer and designer in applying ball bearings to any new machine. The first book deals with principal bearing types and fundamentals of mounting practice; the second, details of shaft and housing designs; and the third, enclosure and lubrication for varying operating conditions; the fourth book gives a new simplified method of computing bearing loads; while the fifth entitled, "Application Procedure," outlines the necessary steps in obtaining assured bearing performance. Ask for Series ES.

54 ADJUSTABLE FLOW REGULATORS

Waterman Engineering Co.—An adjustable flow regulator for cylinder speed control is described. This adjustable regulator gives a constant rate of flow regardless of pressure fluctuations or change in work resistance at any setting within the adjustable range. Adjustable range is 50 per cent of the calibrated flow rate in gpm. It is available for hydraulic systems with operating pressures to 3000 psi. Line sizes are $\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{2}$, and $\frac{3}{4}$ in. NPT (dry seal). Maximum controlled flow is 16 gpm.

55 LINEAR BALL BEARING

Thomson Industries, Inc.—Trade name "Ball Bushings." 12-page illustrated catalog gives complete description of ball bearings available for linear motion and how they can be used to obtain low friction and wear, lasting precision alignment, eliminate binding and chatter, zero shake or play, long life-low maintenance, to solve sliding lubrication problems. Catalog also contains engineering information on suitable shafts, seals, dust boots, lubrication, installation data, and mounting arrangements, along with charts and tables for calculating load capacity and bearing life.

56 DOWTHERM VAPORIZERS

Union Iron Works—Union offers a helpful bulletin for users, or potential users, of Dowtherm "A" or "E." Tables of chemical and physical characteristics are included, as well as pertinent dimensions of several sizes of Dowtherm vaporizers. Union engineering, manufacturing, and installations service covers a wide range of sizes and types of Dowtherm systems.

57 INSTRUMENTS—RECORDERS

Brush Development Co.—Brush oscillographs, amplifiers, acoustical instruments, recording analyzers provide immediately usable, permanent records on electrical, mechanical, or acoustical investigations on items such as surface finish, textile fiber uniformity, d-c or a-c voltages or currents, strains, displacements, light intensities, temperatures, other static or dynamic conditions.

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A good book to consult for authorized definitions of approximately 500 occupational specialties in engineering.

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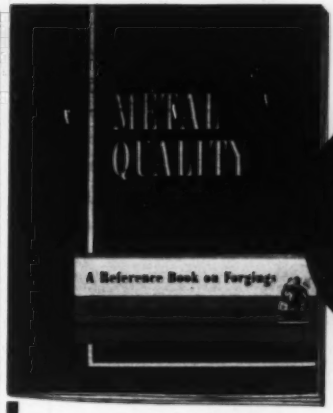


Engineering, production and economic advantages obtainable with forgings are presented in this Reference Book on forgings. Write for a copy.

Forgings fortify a mechanism with a factor of greater safety that is otherwise unobtainable... There is no substitute for the toughness and strength inherent in the compact, fiber-like flow line structure of closed die forgings. Consult a Forging Engineer about the correct combination of mechanical properties which forgings can provide for your product.

DROP FORGING ASSOCIATION

605 HANNA BLDG. • CLEVELAND 15, OHIO

Please send 60-page booklet entitled "Metal Quality — How Hot Working Improves Properties of Metal", 1949 Edition.

Name .....

Position .....

Company .....

Address .....

58 FEEDWATER REGULATORS

Northern Equipment Div.—Continental Foundry & Machine Co.— New Bulletin No. 491 concisely describes and tabulates engineering data for COPES simple-level, flowmatic, and balanced flow feedwater controls, also for differential, pump governor, pressure reducing, and balanced valves, also for desuperheaters, liquid level controls, and hi-lo water alarms.

59 BIN LEVEL INDICATOR

Bin-Dicator Co.—New 1952 catalog fully describes and illustrates bin level indicator which gives automatic control of machinery in response to fluctuating level of materials in silos, bins, hoppers, conveyers, etc. Dimensional drawings, mounting details, typical applications, wiring diagrams, and list of present users. Illustrated applications to stoker operation, flour packing, chemical proportioning, concrete mixing plant, packaging ores, salt, feed, chemicals, candy, etc.

60 SPREADER STOKER SELECTION

American Engineering Co.—14-page form F-520-A10M is intended to help those choosing a spreader stoker to get the most for their investment, and it points out many factors to be considered in the selection. It pictures and describes in detail the principle operating parts of manufacturer's stokers emphasizing their advantages. Includes engineering drawings and photos of several typical installations.

61 INSTRUMENT VALVES

Edward Valves, Inc.—Bulletin No. 491 providing information on the new drop-forged steel Edward instrument valves for meter, gage, instrument, and other small lines. These new valves have a rating of 6000 lb WOG at 100 F or 1500 lb sp at 1000 F. Bulletin contains dimensions, weights, prices, and operating data.

62 WORM GEAR SPEED REDUCER

Cleveland Worm and Gear Co.—Catalog 400 (1952 edition) illustrates and describes all models in the Cleveland Worm Gear Speed Reducer line. Its 180 pages present engineering data on each type, including dimensions, weights, and horsepower capacities—all the information needed to arrive at proper selections of drives for any kind of power-driven equipment.

63 OPEN STEEL FLOORING

Open Steel Flooring Institute, Inc.—New 16-page idea-book, "Versatile—Open Steel Flooring," is illustrated with installation photographs showing the many and varied possibilities for using steel grating. It explains types and features of open steel flooring and specifications for insuring quality open steel flooring and its proper installation.

64 MATERIALS HANDLING

Mathews Conveyer Co.—Catalog 848 defines scope of the engineering and manufacturing operations of Mathews Conveyer Co., and shows how the company is serving industry with gravity and power conveyers, and special conveying machinery.

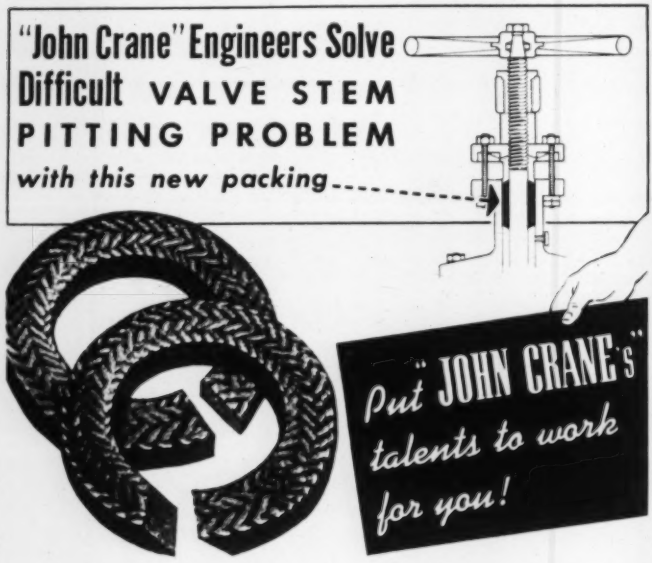
65 FAFNIR FLANGETTE

Fafnir Bearing Co.—6-page Folder describes a complete power transmission unit, incorporating a Fafnir wide inner ring ball bearing, and self-locking collar. Housings are interchangeable steel flanges with inside surfaces matching bearing outer ring, thus providing initial self-alignment in all directions. Folder carries photos, installation instructions, sizes, and load ratings.

66 HYDRAULIC OIL POWER EQUIPMENT

Vickers Inc.—Catalogs I-5000 and M-5100 contain general design information and specifications of a complete line of pumps, valves, controls; and related equipment for oil hydraulic power transmission in machine tool (general industrial field) and mobile equipment industries, respectively. Individual units, also standardized or custom-built power units, transmissions, and control panels available.

"John Crane" Engineers Solve Difficult VALVE STEM PITTING PROBLEM with this new packing



One of the nation's leading valve manufacturers* was confronted with the problem of 410 and 416 chrome-steel valve stem pitting during storage. "John Crane" Engineers were asked to solve the riddle which had proved very costly. This resulted in the development of a new packing (Style 187) which contains a special sacrificial metal used to short-circuit the electrolytic action that causes pitting. This company has used the new packing over a year and is thoroughly satisfied not only with its corrosion inhibiting qualities but also its operating performance on steam to 850° F.—1500 psi.

This is a typical example of the thousands of packing problems "John Crane" has solved throughout industry. Why not give us the opportunity of working with you to find the most practical and economical solution to your particular problems?

*Name sent on request.

Write today for complete details

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1814 CUYLER AVENUE • DEPT. ME4 • CHICAGO 13, ILLINOIS

The Latest Industrial Literature

offered in this list represents recently issued Catalogs, Bulletins, Handbooks, Data, Booklets, Charts, Informative Folders and other engineering information made available by current advertisers in ASME Publications.

CATALOG GUIDE

67 CHAIN-GRATE STOKERS

Illinois Stoker Co.—Catalog describes a chain-grate stoker with medium-height side frames for installation under boilers up to about 500 hp. The side frames are of ample height to admit sufficient air required for combustion and this construction saves at least one foot in the setting height of the boiler. The stoker is used for either free-burning bituminous coal or anthracite.

68 SUPER REFRACTORIES

Carborundum Co.—Form 5120, "Super Refractories By Carborundum," deals with the ability of these products to perform under a variety of chemical, temperature, load, and abrasive conditions. Included are, permeability, expansion coefficient, and reaction to heat shock. The text material is supplemented with many charts, tables, and illustrations, together with application data.

69 IRON CEMENTS

Smooth-On Manufacturing Co.—40 page, pocket size Smooth-On Repair Handbook describes practical, timesaving, money-saving repairs made on plant, shop, factory, garage, and home equipment with Smooth-On iron cements. Leaks stopped, cracks sealed, loose parts, and fixtures tightened. More than a million copies of this popular Manual have already been sent out in response to requests. Contains 170 diagrams. Clear tested directions.

70 HYDRO-PNEUMATIC PUMP

Aldrich Pump Co.—Data Sheet 69A gives details of construction, design, operation on the improved Aldrich-Lytle Hydro-Pneumatic Unit. This double-acting duplex pump uses plant air as power medium; generates up to 20,000 psi at small volume. It is used in testing tubing, valves, pressure vessels; also for the operation of small molding presses.

71 OIL SEALS

Johns-Manville—Clipper Seal brochure describes complete story of this precision-molded oil seal that provides efficient bearing protection at low cost. Includes photographs and diagrams of typical installations; shows how various lip designs provide choice of bearing surfaces; how its simple one-piece construction allows greater freedom in designing oil-seal cavities.

72 INDUSTRIAL OIL BURNERS

Petroleum Heat and Power Co.—New completely revised 24-page catalog No. 150 offers up-to-date information about Petro industrial (heavy) oil-burning equipment, including combination gas and oil burner for use with fuel oils up to the viscosity of preheated No. 5 oils or 1000 Btu natural gas. Also condensed data on Petro domestic oil-burning equipment.

73 METAL-WORKING PRESSES

American Steel Foundries, Elmes Engrg. Div.—6-page Bulletin 1011 illustrates and describes new Elmes pipeless metal-working presses. Main hydraulic circuit has no piping. All high-pressure fluid is conducted through short, direct passages drilled in structural parts. Result is low-cost maintenance with down time practically eliminated.

74 ELECTRIC WELD TUBE MILLS

Yoder Co.—68-page book of information on the mechanics as well as the economics of converting coiled strip into welded mechanical tubing, conduit boiler tubes, furniture tubing, etc.; physical properties of products, end uses, output per man hour; materials suited for tube making; scrap losses, welding speeds and power consumption; continuous feeding; formula for strip widths, etc.

75 FLEXIBLE, SWIVEL, SWING, AND REVOLVING JOINTS

Barco Mfg. Co.—For piping and lines conveying steam, oil, air, gasoline, water, chemicals, including corrosive acids and alkalis, and other fluids or gases. Types for pressures up to 750 psi, steam, and 6000 psi hydraulic. Complete range of sizes. Catalogs No. 215 "Flexible Ball Joints"; No. 265 "Rotary Swivel Joints"; No. 400 "Barco Swing Joints"; No. 300 "Revolving Joints."

76 DUST CONTROL EQUIPMENT

Dracco Corp.—Bulletin 304 presents complete technical information on Dracco Multi-Bag Filters for controlling or collecting industrial dusts of all kinds. Operational features are explained and filter specifications are listed in table form. Also included are sample calculations for a typical dust control system, volume and air resistance tables, and installation photographs.

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In the drilling, refinery or pipeline operation on both new equipment and maintenance work, specially compounded Parco "O" Rings do the job better. Parco "O" Rings are rubber combinations blended to meet your specifications and molded to tolerances that make them superior seals for both static and dynamic use. For your assurance and best protection of smoother running and longer wearing hydraulic seals, insist on Parco. Other Parco rubber products used in the oil industry meet the same high standards of Parco "O" Ring quality. Specify a superior product at no premium to you. All dash numbers of 6227, 6230 and 6290 series for commercial applications or Army-Navy installations to Specifications MIL-P-5516 (6227 and 6230) and MIL-G-5510 (6290) are available from stock. Silastics and other special compounds are available on order.

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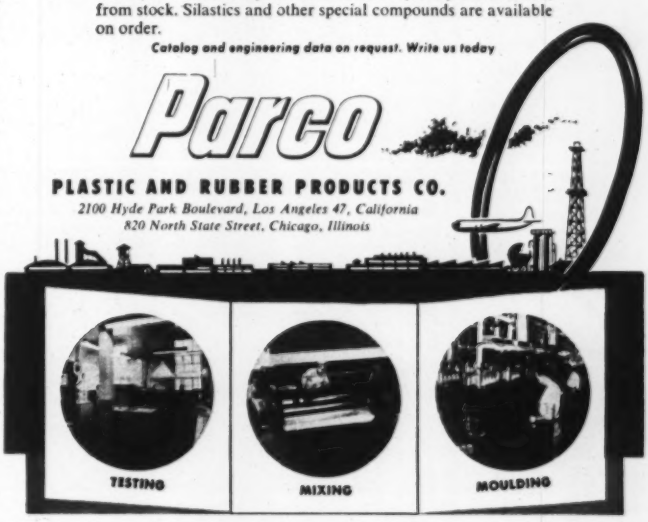

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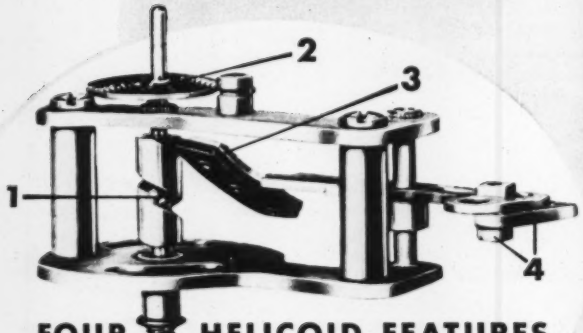
The greatest achievement of the gage makers' craft—pressure gages without gears. The Helicoid movement... tested and proved in years of hard service ... is a simple cam and roller arrangement that gives long, trouble-free service.



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• HELICOID GAGES, which do not have gear teeth to wear out, are made in a full range of pressures... in various sizes and shapes, with black, white and radiant faces. For wall or stem mounting, flush or panel mounting, or flangeless. No finer gages are made. Helicoid Gages cost less in the long run.

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CATALOGUES

77 CAST-IRON PULLEYS

W. A. Jones Foundry & Machine Co.—Catalog No. 83, shows standard as well as special pulleys, contains engineering data to help you with your design problems and complete price information on all types of standard pulleys.

78 CEMENT-LINED PIPE

Centriline Corp.—Booklet describes proved method of (1) permanently increasing and maintaining carrying capacity; (2) stopping and preventing leaks; and (3) preventing discoloration of water from corrosion. Typical installations and results are described.

79 PNEUMATIC ATOMIZING NOZZLES

Spraying Systems Co.—11-page illustrated catalog No. 23 lists wide range of types, sizes, and materials as standard equipment to meet exact needs in capacities, spray types, and characteristics for atomizing any liquid that flows; for industrial and chemical processing and scientific research.

80 EXPANSION ROOF TANKS

Graver Tank & Mfg. Co., Inc.—New 20-page booklet offers descriptive data on the operation of the Graver Expansion Roof design, by which costly breathing losses can be eliminated in stored gasolines. Details on installation, design, and long service are included. A technical section is well implemented with graphs and tables to provide a basis for a thorough analysis of the vapor conservation achieved by this design.

81 VACUUM CLEANER

Spencer Turbine Co.—Industrial Vacuum bulletin 125-D shows many unusual applications. Different types of work can best be handled by a stationary vacuum system and some by a portable. Spencer manufactures both, from 1 hp up. Vacuum is used for conveying, collecting, reclaiming, and others. Standard vacuum cleaners are used to clean walls, floors, pipes, and out of the way spots by changing only the tool.

82 FANS

New York Blower Co.—Portable self-contained units of medium capacity for ventilating and industrial applications. New 8-page bulletin, No. 512, describes these fans, furnished in four types and nine basic sizes with capacities from 160 cfm to 18,000 cfm, together with dimensions and engineering data.

83 SCRAPED SURFACE EXCHANGERS

Henry Vogt Machine Co.—Bulletin PE-1 describes the operation and application of these units for use as chillers, crystallizers, and heaters. Also shows sectional drawings, typical assemblies, and lists uses.

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CATALOGS & LITERATURE

84 FLUID POWER EQUIPMENT

Oilgear Co.—8-page Bulletin 10051-B illustrates and describes complete line of fluid power pumps, motors, transmissions, cylinders, and valves. It features a new line of constant delivery pumps for pressures up to 5000 psi and variable delivery pumps, a new line of axial piston motors, an improved line of standard cylinders for pressures up to 1500 psi, and a new line of heavy-duty cylinders for pressures up to 3000 psi. It introduces standard line of pilot and directional control valves, relief and foot valves, surge (pre-fill) valves, combination valves, differential valves, and auxiliary fluid equipment for pressures up to 3000 psi.

85 WATER TUBE HEATING AND POWER BOILERS

International Boiler Works Co.—Catalog and specification sheet describing water tube steel heating and power boilers, includes pictures and cuts showing effective baffling arrangements which provide economical performance with all fuels and any method of firing. Made in standard sizes from 10 to 600 hhp. See our performance data in 1952 ASME Mechanical Catalog and Directory, page 188.

86 NYLON LINED BEARING

Thomson Industries, Inc.—Trade name NYLINED Bearings. Four-page illustrated brochure outlining the basic advantages of nylon as a bearing material and showing how its use in the NYLINED construction principle enables a bearing for less friction, longer life, dry operation, corrosive conditions, and silent operation. Literature also describes how the NYLINED principle overcomes many of the limitations of plain molded or machined nylon bearings.

87 AUTOMATIC CONTROLS

Mercoid Corp.—A complete line of automatic controls and mercury switches are illustrated and described in Mercoid catalog No. 700A. These electrically operated controls cover a wide range of applications involving the automatic control of pressure, temperature, liquid level, and for lever arm mechanical operations. Various types of mercury switches are made in numerous circuits.

88 INDUSTRIAL AIR COMPRESSORS

Clark Bros.—A 48-page profusely illustrated catalog 118 on modern heavy-duty industrial air compressors covers a 150 to 4500-hp range. Absence of unbalanced forces in Clark balanced/opposed compressors results in absolutely vibrationless operation. This permits installation anywhere with a minimum of foundation and negligible maintenance. Shipped completely assembled for rapid installation.

89 ELECTRIC MOTORS

Howell Electric Motors Co.—"Red Band" Motors customers' price catalog available and also descriptive bulletins separately describing motor types including general-purpose squirrel-cage induction motors totally enclosed, elevator motors, explosion-proof, multispeed and sanitary motors, and also a bulletin on fractional horsepower ratings. Also condensed price sheets and bulletins AC-2 are available, the latter listing recommendations for various types of motors used on typical applications. The company specializes in industrial a-c motors from 1/20 to 200 hp.

90 ROLLER GRAVITY CONVEYERS

Lamson Corp.—A completely new, plastic bound, roller gravity conveyer catalog which is complete with detailed specifications of a range of sizes of roller gravity conveyers and numerous installation photographs to show various types of applications. This is designed to be of assistance to the plant or material-handling engineer because it contains complete data as to the selection and use of various types of roller gravity.

91 O-RINGS

Linear, Inc.—Compact 6-page folder contains tables of standard O-ring sizes as well as dimensional data for installation. Notes give general recommendations on clearances, design, material, machining, and finishes for most O-ring applications. A special compound bulletin containing descriptions of the latest polymers and synthetic rubbers from which O-rings can be molded is also included.

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We have used Slo-Speeds for years on many types of special machinery we manufacture and can report complete satisfaction with their performance, states Frank Fluckinger of Fluckinger Machine Works, Seattle. Their streamlined design enhances the appearance of our equipment . . . their compact, self-contained construction and versatile mounting features facilitate installation, add to safety in operation, and make them adaptable to our varied requirements.

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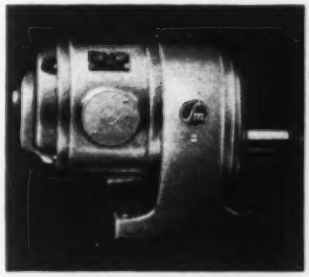

GIVES YOU THE ONE BEST LOW SPEED AND

gives uninterrupted service — carries heavy overhung loads — provides versatile mounting and flexibility in arrangement of machinery — saves valuable space — provides greater safety — costs less to install and use. An indispensable source of low speed power for:

Agitators	Dryers	Presses
Blenders	Feeders	Pumps
Blowers	Kilns	Screens
Conveyors	Mills	Tumblers
Cookers	Mixers	Etc., etc.

70 ILLUSTRATIONS showing how Sterling Electric Power Drives reduce production costs. Write for Bulletin No. C-101.

STERLING ELECTRIC MOTORS

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BLOWERS

provide air to the specific needs of many important industries because Standardaire Blowers are unique in design and construction—unequalled in quality and performance.

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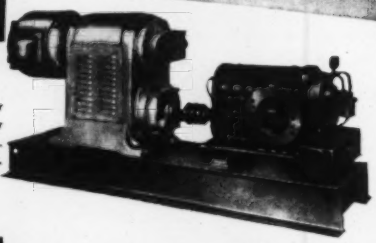
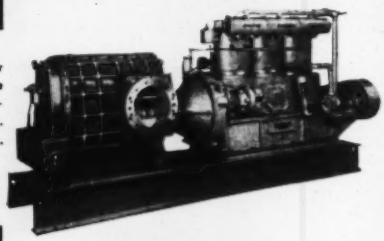


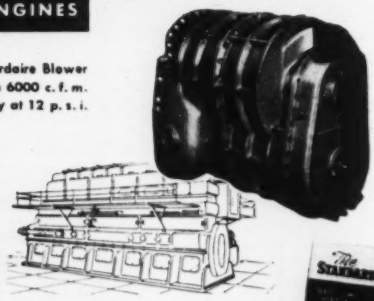
Standardaire Blower with Varidrive Motor to deliver 780 c. f. m. at 1750 r. p. m.

for **SEWAGE PLANTS**



Standardaire Blower with Climax Engine using sewage gas—to deliver 2100 c. f. m. at 720 r. p. m.

for **DIESEL ENGINES**



Standardaire Blower with 6000 c. f. m. capacity at 12 p. s. i.

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Write DEPT. F-53 for Publication No. 90

BLOWER-STOKER DIVISION

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92 CORROSION-RESISTANT VALVES

Rockwell Mfg. Co.—Catalog V-217, "Rockwell-Built, Nordstrom Corrosion Resistant Valves," designed specifically for use in the process industries, describes types, operation, and features of Nordstrom corrosion resistant valves. Tables are included listing approximately 175 different chemicals, with special reference to their recommended alloys and lubricants. Typical chemical analyses are made of bronze, Mercoloy, Ni-Resist, stainless steel, nickel, monel, and Hastelloy. In addition to size and specification tables, over 100 illustrations show valve sizes, types, and practical applications in the process industries.

93 UNIT HEATERS

Grinnell Co.—Catalog UH-1950 illustrates and describes horizontal and vertical delivery and textile types of Grinnell Thermoliers. Textile type self-cleaning for use in dusty, lint, and fly-laden atmospheres. Complete capacities, dimensions, weights, motors, wiring diagrams, piping connections, and methods of suspension. Exclusive features described and illustrated.

94 BORING AND TURNING MACHINES

American Steel Foundries, King Machine Tool Div.—New 2-color catalogs, fully illustrated, containing complete description and specifications on King vertical boring and turning machines. Catalog K-1 covers machine sizes 30, 36, and 42 in.; Catalog K-2, sizes 52, 62, and 72 in.; Catalog K-3, sizes 84 and 100 in.; Catalog K-4, sizes 120 and 144 in.

95 FLEXIBLE SHAFT POWER DRIVES

Elliott Mfg. Co.—Catalog No. 207, describes applications of flexible shafts for power drives and heavy-duty power drives. It gives factors which determine specifications and primary requirements in engineering flexible shaft power drives. It lists information required by Elliott engineering service in offering solutions to power transmission problems, without cost or obligation.

96 OIL BURNERS

Cleaver-Brooks Co.—New catalog AD-102 covers complete line of Cleaver-Brooks Hev-E-Oil Burners for commercial and industrial use. Includes illustrations of various models, listings of features, illustrations of applications, listing of specifications, and illustrations of the major feature advantages. The five sizes ranging from units burning 1 to 5 gph to 6 to 60 gph are illustrated.

97 STEAM AND LIQUID CONTROL EQUIPMENT

O. C. Keckley Co.—Catalog No. 51 contains 56 pages of illustrations and engineering data on precision pressure regulators, temperature regulators, float valves, water gages, float boxes, safety and relief valves, strainers, etc. Drawings, layout diagrams, dimensions, and capacity tables are included.

98 BEARING SELECTION

W. A. Jones Foundry & Machine Co.—Catalog No. 88, a 24-page bulletin on "Timken Equipped Pillow Blocks" contains many illustrations and good engineering information on the rating and selecting of bearings.

99 EXTRUDED ALUMINUM

Aluminum Company of America.—Booklet contains a discussion of design and production advantages of aluminum extrusions. Illustrations of the way several extruded shapes can be combined to simplify assembly and reduce costs. Data on size and shape limitations, alloys, section thickness, tolerances, die costs.

100 BIN-FLO AERATOR UNIT

Bin-Dicator Co.—4-page bulletin BF-1 with enclosures gives complete description and illustrations of unit; application data, typical layouts, air pressure consumption, supply and piping data, specifications, prices, and installation instructions; and list of present users. Simple low-cost device provides uniform and continuous flow of dry, finely ground materials from bins, hoppers, and chutes by introducing small volumes of low-pressure air.

101 STOKERS

Flynn & Emrich Co.—Bulletin No. 1301 contains information and illustrations covering the F&E spreader stoker which incorporates in its design and construction all of the advanced engineering found in the spreader-type stoker of today. The electro-hydraulic drive, incremental hydraulic control valve, and alternate pusher coal feed are a few outstanding features. Bulletins 1105 and 1204 fully describe F&E underfeed stokers.

CATALOG GUIDE

102 COPPER AND COPPER ALLOYS

Revere Copper and Brass Inc.—Sixth edition catalog offers technical information on coppers, brasses, bronze alloys, nickel alloys, manufactured forms, aluminum products, welding techniques, and gives a condensed list of products.

103 LIQUID METERS

Buffalo Meter Co.—Niagara meter catalog bulletin No. 31 describes the simplest volumetric displacement meters for almost all liquids including cold water, hot water, petroleum products, oils, syrups, solvents, and many corrosive chemicals. Stainless steel meters have proved highly satisfactory for corrosive products. Registers are totalizing for continuous use, set back for batch measurement, or electri-contact type for automatic shut-off of liquid flow.

104 RECIPROCATING PUMPS

Aldrich Pump Co.—New Aldrich Data Sheet 67-A describes the Aldrich 6-in.-stroke direct flow pump Series (3, 5, 7, and 9 plunger units, 300 to 900 hp). This 8-page, 2-color bulletin includes design advantages, sectional drawings, illustrations, performance data, and pump specifications. Pumps are used for descaling and hydraulic systems, chemical and oil field service.

105 FLEXIBLE COUPLINGS

Thomas Flexible Coupling Co.—New catalog 51 gives latest engineering information on Thomas Flexible Couplings. It shows their complete lines of single and double types of all metal flexible couplings for heavy-duty impulse loads such as Diesel-driven compressors, as well as for smooth loads such as motor-driven centrifugal pumps.

106 FIRELESS STEAM CLEANER

Homestead Valve Mfg. Co.—Illustrated bulletin gives features and specifications of a new steam cleaner that operates on any steam supply of 60 to 150 lb pressure. The new unit is said to remove grease and dirt from machinery, equipment, floors, walls, etc., eight to ten times faster than by hand methods, and give more productive hours without added manpower.

107 SPREADER STOKERS

Hoffman Combustion Engineering Co.—Catalog No. 51-CAD describes and illustrates features of moving-grate spreader stokers. Catalog 51-PDG describes, illustrates, and supplies additional information on spreader stokers with dumping grates. Capacities from 20,000 to 250,000 lb of steam per hr.

108 AXIAL-FLOW FANS

Aerovent Fan Co.—11th Edition catalog describes Aerovent "Macheta" axial-flow exhaust and ventilation, 9 to 144-in. direct-connected, belted, extended shaft, mancooler, pulley, duct and belted-duct fans.

109 TEMPERATURE AND PRESSURE REGULATORS

Fulton Sylphon Div.—Robertshaw Fulton Controls Co.—Well illustrated Catalog A describes the Fulton Sylphon line of regulators for temperature and pressure control. This catalog also gives technical information relating to relief valves, pump governors, safety and vacuum regulators. In all there are over 200 pages of illustrations, data, and drawings.

110 BEARING BRONZE

Bearium Metals Corp.—4-page stock list shows weights of over 750 sizes cored and solid bearing bronze bars up to 10 in. OD. Includes information on highly superior frictional properties found in Bearium Metal—a bronze devised primarily for bearings, bushings, and thrust washers.

111 SPEED REDUCERS

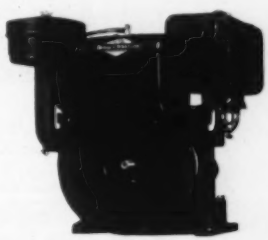
W. A. Jones Foundry & Machine Co.—Bulletin No. 68 covers the latest information on Jones worm gear speed reducers. Heavy-duty machines are furnished in type "H" with worm below gear and in type "R" with worm above gear. They have horsepower ratings in accordance with the recommended practice of the American Gear Manufacturers Association.

112 SLITTERS AND SLITTING LINES

Yoder Co.—Basic information on design, selection, and operation of slitters and slitting lines, time studies and analysis of operating cycle; and coil handling and scrap-disposal methods are presented in 74-page catalog. Specifications, capacity tables, and other data on Yoder standardized series of uncoilers, slitters, recoilers, coil cars, and scrap choppers are given.

THE GREATEST SERVICE ORGANIZATION OF ITS KIND IN THE WORLD . . .

Nearby there is a Briggs & Stratton service organization, factory trained and supervised, and with a stock of *genuine* Briggs & Stratton engine parts ready to serve you. These organizations offer complete Briggs & Stratton engine service — tune up, repair, and rebuilding with original Briggs & Stratton parts.



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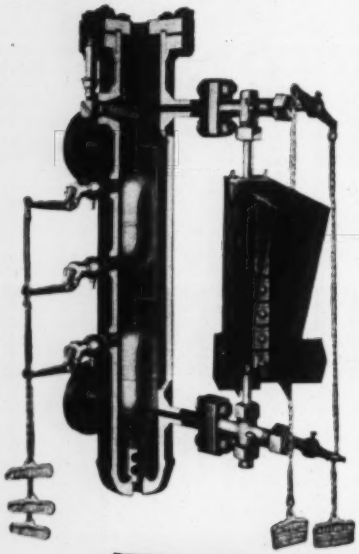
Reliance

Safety Water Columns

... your basic guide to

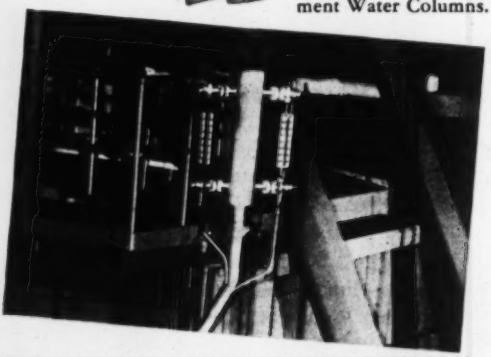
Boiler Water Level Safety



●Keep your power plant from being the subject of a boiler insurance company report. Service without shutdowns from water level accidents can only be assured by constant alertness aided by modern safety devices.

Reliance Water Columns with positive, quick-acting alarms are made for pressures to 900 pounds. They're considered *standard* by leading boiler manufacturers, consulting engineers and government authorities.

For higher pressures, standard and custom-built equipment is available that embodies principles of design and construction perfected by Reliance in 68 years of specializing in this field. Specify Reliance for new or replacement Water Columns.



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The name that introduced safety water columns.... in 1884

Reliance®

BOILER SAFETY DEVICES

DATA-FACT GUIDE

113 EXPANSION ROOF TANKS

Graver Tank & Mfg. Co., Inc.—A new booklet on Graver expansion roof tanks covers single and multiple tank installations, design features, fittings, technical operating data, and operating analysis.

114 STANDARD RATED FURNACES

Surface Combustion Corp.—A new illustrated bulletin, No. SC-151, describes the complete line of "Surface" Standard Rated Furnaces for every toolroom heat-treat requirement. Emphasizing methods of precise heat-treatment for maximum tool life, this bulletin describes controlled atmosphere furnaces and generators in addition to direct-fired, forced-convection, and pot furnaces.

115 STAINLESS STEEL FABRICATION

U.S. Steel Subsidiaries.—136-page handbook describes stainless steels produced by U.S. Steel, lists all properties, and provides complete details on end use and fabricating practices. Includes data on welding, riveting, soldering, joint design, machining, cutting, forming, annealing, pickling, and surface finishing and protection.

116 VALVES

Wm. Powell Co.—New 589-page No. 11 General Catalog describes in detail the standard Powell bronze and iron valves, quick-opening valves, and all-iron valves.

117 CHUCKS, AIR AND WRENCH OPERATED

Cushman Chuck Co.—Catalog PO-64-1952, listing air operated chucks, air cylinders and controls; gives prices and engineering data on chucks and cylinders designed to operate without clatter at high speeds to provide low cost, timesaving tooling. Catalog 64-1952 listing wrench operated chucks; gives prices and engineering data on chucks recommended for engine, toolroom, manufacturing turret, and automatic lathes.

118 ELECTROSTATIC PRECIPITATORS

Koppers Co., Inc.—Precipitator Dept.—Folder describes Koppers Elex electrostatic precipitators in features and performance. Specific operating results are given as well as suggested applications in nuisance elimination, cleaning of process gases, or recovery of valuable products.

119 DRAFTING-MACHINE SCALES

Universal Drafting Machine Corp.—Bulletin gives complete information on the advantages of this extremely accurate, ground from the solid, aluminum scale, and in addition provides a valuable chart of ¾ size actual scale photographs showing all the standard Duraline Scale graduations commonly used by engineers, draftsmen, architects, and designers. It also provides an explanation of scale terminology in general use—to aid buyers when writing for information on specially graduated scales for special uses.

120 ELECTRIC BRAKES AND CLUTCHES

Warner Electric Brake & Clutch Co.—Catalog No. 701-A contains information on complete line of electric brakes and clutches for industrial application. Contains general description, torque values, and general data pertaining to all sizes. Complete capacity tables, dimensions, and specifications are included.

121 RADIAL-THRUST ROLLER BEARINGS

Shafer Bearing Corp.—Latest 56-page catalog gives complete specifications of Shafer ConCaVex radial-thrust roller bearings, featuring full capacity self-alignment within the bearing itself. Available in unmounted single and double-row style, or in double-row mounted units as follows: Pillow blocks, flange units, cartridge units, flange-cartridge units, duplex units, take-up units, take-up and frame units. Mounted units available in normal duty, standard heavy duty, and adapter mounting types as well as in "Specials."

Read the various items listed . . . one catalog may hold the solution to your present problem . . .

CATALOGUE

122 COLD-HEADED PARTS

Townsend Co.—Townsend Cold-Headed Parts for Military Applications is a new 12-page illustrated pamphlet, No. TL-64, which describes special parts manufactured by Townsend for a wide range of military items. The pamphlet discusses how to design for cold-heading and describes Townsend manufacturing facilities.

123 HYDRAULIC ELECTRIC POWER UNITS

American Blower Corp.—Gyrol Fluid Drive Hydraulic Electric Power Units. "Power in a Package" pictorially described in Bulletin No. 8519. Bulletin mentions applications, shows illustrative test photographs, and includes ratings and dimensions.

124 COOLING TOWER EQUIPMENT

J. F. Pritchard & Co.—Complete line of specialized equipment is covered by latest illustrated catalog No. 1.19.092A. In addition to describing medium and large mechanical draft cooling towers, atmospheric types, and small packaged models, catalog provides information on cooling-tower nozzles, fans, fan drives, air and gas-treating equipment, and air-cooled heat exchangers.

125 POWER PRODUCTS DIRECTORY

Allis-Chalmers Mfg. Co.—This 40-page directory, 25B6057, lists the more than 1600 Allis-Chalmers products made for power generation, power distribution, and power utilization together with engineering literature available on a wide range of equipment for the farm, mine, industry, and utility.

126 THERMOSTATS

Fenwal, Inc.—Catalog on unique Thermoswitch* heat control, a precision thermostat having outstanding advantages of instant response, high accuracy, wide range, rugged construction and ease of installation. Catalog describes wide application and gives full engineering details, and shows how Thermoswitch unit can often replace expensive control instruments. (*Reg. U. S. Pat. Off.)

WANTED

MORE IRON AND STEEL SCRAP... OF ALL KINDS!

Steel mills and foundries need more scrap.

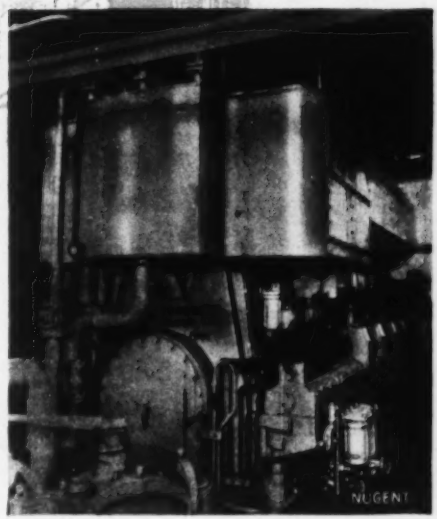
Not just "production" scrap from metal-fabricating plants . . . but also all sorts of *idle* iron and steel—from all types of plants.

Search *your* plant for this idle metal . . . work with your local scrap dealer to increase supplies of badly-needed iron and steel scrap.

What to look for . . .

obsolete machines, tools and equipment, no-longer-used jigs and fixtures, worn-out or broken chains, wheels, pulleys, gears, pipe, tanks, drums and abandoned metal structures. Non-ferrous is needed, too!

Down in the bayous NUGENT FILTERS *help guard Houma's power supply*



Above — Nugent filters of the type used for actuator oil at Houma. Right — Fuel filter of the type used for pilot diesel fuel.

DEEP in Louisiana's beautiful bayou country, the City of Houma has recently passed the second anniversary of its diesel power plant . . . and, as is true in so many installations where dependability and continuity of service is important, Nugent Filters are used to help protect the engines. The engines are three 2000 H.P. Nordberg gas burning diesels . . . the Nugent filters are used to remove impurities from pilot fuel oil and actuator oil.

Wherever engines must give long dependable service, Nugent filtering is a must. Offering more effective filtering at lower cost, Nugent Filters are available in a complete range of sizes and types to meet every filtering need. Write for full data, outlining your filtering requirements.

Wm. W. Nugent & Co., Inc.

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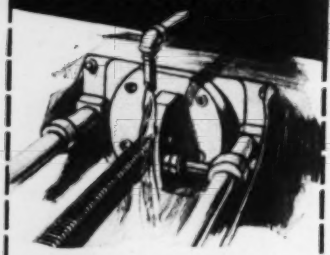
TOUGH or EASY machining...



MORE THAN A "COOLANT" IS NEEDED

LITERALLY thousands of plants will testify that Stuart cutting fluids have been their only answer on *really tough* machining jobs. The research and experience that makes Stuart a leader on the tough jobs pays real dividends on the easy jobs. Stuart knows that *more than a "coolant" is needed* — that cooling, lubricity and anti-weld characteristics must be combined in a cutting fluid if optimum finish, tool life and production are to be secured.

This doesn't mean that you must have a different cutting fluid for every job, but it does mean you need a cutting fluid that is *right* for the job.

Send for NEW BOOKLET "MORE THAN A COOLANT IS NEEDED" and ask a Stuart representative to show you how the planned application of Stuart cutting fluids will give you more output, longer tool life, better finish and lower cost.

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EST. 1865

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BUYER'S CATALOGS GUIDE

127 SPRINGS

American-Fort Pitt Spring Div., H. K. Porter, Inc.—This catalog contains complete information on the various types of hot and cold-wound springs manufactured by the company. By means of photographs, cross sections, and drawings, the booklet provides specifications for standard railroad springs, as well as descriptions and formulas for working out the requirements of compression, extension, and torsion springs.

128 ROLLER BEARINGS

Shafer Bearing Co.—Engineers and specifiers of industrial roller bearings and mounted units will be interested in 56-page catalog 51. Illustrates and describes full line of roller bearing units plus unmounted roller bearings. Design features such as concave rollers operating between matched convex races, and the advantages of this design are fully discussed. Of interest are larger models of bearing units with standard shaft sizes now available up to 5-in. diam. Also contains complete engineering and load rating data and illustrates many product applications.

129 OIL FILTERS AND OILING DEVICES

Wm. W. Nugent & Co.—A set of six Bulletins in a binder. Each bulletin profusely illustrates and describes a Nugent product such as: Gravity Liquid Filters; Pressure Liquid Filters; Oiling Devices; Sight Feed Valves; Sight Flow Indicators; Compression Union Pipe Fittings; Automatic Oil and Water Separating Tanks; Oiling and Filtering Systems. These products are for large Engines, Pumps, Compressors, Gear Reduction Units, etc., and all kinds of machinery used in Rolling Mills, Cement Mills, Power Plants, both Stationary and Marine, and Railroads.

130 SOCKET SCREWS, PLUGS, DOWEL PINS

Standard Pressed Steel Co.—Unbrako "Standards" bulletin displays in two colors all the standard sizes available in the entire Unbrako line, including socket head cap screws; self-locking socket set screws (with knurled cup point); socket set screws (standard points); shoulder screws; flat head socket cap screws. Dryseal thread pressure plugs, square head set screws, precision-ground dowel pins, and hexagon socket screw keys.

131 PISTON RINGS

Koppers Co., Inc.—Piston Ring Dept.—16-page folder describes Koppers "American Hammered" piston rings for industrial use. Individual ring types shown with specifications for use in combustion engines, hydraulic systems, compressors, etc.

132 COIL SPRINGS, WIRE FORMS, AND METAL STAMPINGS

Dudek & Bock—Bulletin shows how the manufacturer's free design service can save users many dollars. Learn of the special instruments developed to take the guesswork out of specifying, inspecting, and testing. Includes valuable engineering charts and data in easy-to-understand language.

133 RECIRCULATION STEAM GENERATORS

Combustion Engineering-Superheater, Inc.—A new bulletin featuring the C-E Recirculation steam generator. Either oil or gas-fired, a complete steam plant with fuel, air, and water all co-ordinated automatically under push-button control. Most compact of all currently available so-called "Package" boilers the C-E recirculation steam generator is available in steam capacities ranging from 2800 to 6000 lb of steam per hr.

134 MICRO BALL BEARINGS

New Hampshire Ball Bearings, Inc.—Technical catalog lists a line of midget bearings fully ground to ABEC 5 or better precision tolerances. Includes Conrad (retainer) type, flanged-type, and spring-separator type for low starting torque. Size range—0.0400 in. bore to ¼ in. OD.

135 VIBRATION CONTROL SYSTEMS

Lord Mfg. Co.—The originators of vibration and shock control through use of rubber bonded to metal offers complete engineering and product manufacturing services. General catalog No. 900 describes basic types of commonly used products and methods of application. Company designs and manufactures vibration control systems for all types aircraft and electronic machinery and equipment.

136 AIR-COOLED ENGINES

Wisconsin Motor Corp.—Well-illustrated "Power Magic" brochure lists all of the heavy-duty features that have made Wisconsin engines predominant favorites on the farm, in the construction and industrial fields, on the railroads, in the oil fields, and in many other fields. Brochure also contains power curves and specifications on all models and world-wide list of distributors.

137 ASH AND FLY-ASH CONVEYERS

Hahn Equipment Corp.—Six-page catalog with supplements describes and illustrates an economical pipe-line or pneumatic unit in team consumption and maintenance. Great stress is laid on the best layout in every given case. Existing conveyers can be easily improved with considerable economies in operation and maintenance.

138 HIGH-SPEED PHOTOGRAPHY

Wollensak Optical Co.—Technical bulletin describing Fastax high-speed motion picture cameras, high-speed oscillographic or streak recording cameras, combined oscillographic and high-speed motion-picture cameras, as well as complete line of accessory equipment, including film for high-speed photographic studies.

139 STEAM GENERATORS AND FURNACES

Petro-Chem Development Co.—Two Technical Bulletins: 50-1 and 50-2, which describe and illustrate Iso-Flow Steam Generators and Iso-Flow Furnaces. Bulletin 50-2 contains a detailed summary of the design and operating characteristics and

Read the various items listed . . . one catalog may hold the solution to your present problem . . . and select those of interest to you. *Distribution by us to students is not included.* The coupon on page 42 must be mailed on or before May 15th in U. S., May 24th elsewhere.

operating test data on a 30,000 lb per hr Iso-Flow steam generator installation. Bulletin 50-1 describes and illustrates the Petro-Chem Iso-Flow furnace, radiant convection design, and includes the significant design and operating characteristics of these cylindrical furnaces which are in extensive use throughout the petroleum, chemical, and allied industries.

140 CONVEYER ROLL BEARINGS

Marlin-Rockwell Corp.—M R-C conveyer roll bearing bulletin (Form 1529) is a 4-page 8½ × 11-in. illustrated folder on M-R-C CONV-3 SF and CONV-4 SF ball bearings. These bearings are specially designed for use on conveyer rolls, and have four important features, resulting in reduced machining operations, cheaper mounting costs, reduced belting cost, and improved belt alignment.

141 HEAVY DUTY ROTARY UNLOADER

United Conveyor Corp.—Bulletin describes new development for installation in the larger industrial and central-station plants, used for conditioning ash, fly ash, and dust to completely eliminate dust nuisance when discharging materials from storage bin to trucks or railroad cars. Unloader has capacities ranging up to 100 tons per hr and main unit is driven with 10-hp motor. A 1 hp motor drive is furnished for the feeder.

142 TEMPERATURE REGULATORS

Powers Regulator Co.—Bulletin No. 316 describes a new expansion-stem-type regulator used to maintain liquids or air at any temperature by controlling pneumatic or water-operated diaphragm valves or dampers. It is of simple rugged construction which withstands vibration. It has adjustable sensitivity, and overheat protection, calibrated dial adjustment, temperature ranges from 50 to 250 F and 150 to 350 F, and easy installation.

143 PUMPS AND SEPARATORS

Kraissl Co.—Catalog in loose-leaf form gives data on products and indicates as briefly as possible the important features of each product or item. The recent loose-leaf additions to this catalog include the new Kraissl class 23 series air pumps for the printing and packaging machinery field, which require no oil lubrication. Other data sheets describe the complete line of Kraissl separators including both strainers and filters.

144 NONABSORBENT INSULATION

Insul-Mastic Corp. of America—32-page catalog describes a protective coating and insulation combined. It is spray applied in coating form ¼ in. thick. It stops 65% of heat loss or controls condensation. Prevents corrosion by repelling moisture. Temperature range—40 F to 300 F.

145 FLAT LAPPING

Crane Packing Co.—16-page booklet, fully describing the new "Lapmaster" method of flat lapping to extremely close tolerances on an automatic, high production basis. Photographs, diagrammatic drawings, and complete data on "John Crane" Lapmaster Models "12", "24", "36", "48", and "72" provide profitable information for all industries whose manufacturing operations include finishing parts to precision surface flatness and finish.

146 PRESSURE GAGES

Helicoid Gage Div., American Chain & Cable Co.—New 16-page Helicoid gage catalog. The Helicoid gage is the only pressure gage with the Helicoid movement. It is guaranteed accurate to within ½ of 1 per cent of the total dial graduation over the upper 95 per cent of the 270-deg dial arc. This means that on a 100 lb dial for example, accuracy is guaranteed to within ½ lb over the entire scale except from 0 to 5 lb. Cutaway photographs and line drawings show the complete line of Helicoid gages.

147 OIL BURNERS

Hauck Mfg. Co.—How guesswork and product spoilage can be minimized on industrial heat processing furnaces, is explained in 24-page catalog No. 410 describing the Hauck proportioning oil burner. Cutaway views illustrate the single lever control design for regulating both oil and air simultaneously. Fuel-air ratio is automatically maintained at all firing rates.

148 SPEED REDUCERS

De Laval Steam Turbine Co.—New 48-page bulletin describes complete line of De Laval double worm gear and helical worm gear speed reducers. The bulletin includes complete data on ratios, horsepower, output torque, and center distances of each style. Information on how to select double reduction gearing, examples of selection, horsepower rating tables, dimension sheets, and complete physical data is included.

149 AUTOMATIC VALVES AND CONTROLS

A. W. Cash Co.—Bulletin No. 330, reviews in the briefest possible manner the more commonly used valves, regulators, and controls for pressure regulating, volume flow, and liquid level. The illustrations and descriptions shown in the bulletin, brief as they are, will show the broad scope of automatic control, and suggest the possibilities which proper application of these devices can serve.

150 ROLLING DOORS

Kinnear Mfg. Co.—New 32-page fully illustrated bulletin No. 72 on a galvanized steel sectional overhead-type door that combines durability with operating convenience and facilities for glass light sections in a door for all types of commercial and industrial service openings is offered. It gives details, clearance requirements, and available accessories.

151 DEAERATING HEATERS

Graver Water Conditioning Co.—Catalog WC-106 describes details of design and operation of Graver tray deaerating heaters for any required capacity. Other valuable facts are presented concerning application, component parts, materials of construction, and distinctive features of Graver designs. Many installation photographs, flow diagrams, and curves have been included in this new catalog to make the text readily understandable.

152 ELECTRIC HEATING UNITS

Edwin L. Wiegand Co.—Chromalox Industrial Electric Heating Unit Catalog 50 lists strip, Finstrip, ring, and cartridge elements; oven and duct heaters; wide range of immersion and circulation heaters, all-metal infrared heaters, unit heaters, hot plates, thermostats, contactors, and hardware. Includes detailed specifications, uses, prices, and application data.

153 GENERAL PURPOSE TURBINES

Westinghouse Electric Corp.—Booklet No. B-3806. The type-E turbine will perform a number of jobs well even under abnormal operating conditions. Designed for economy and dependability in continuous or stand-by operation. An excellent means of effecting steam expansion without loss of energy. Fully illustrated and diagramed.

154 TENSIOMETERS

Central Scientific Co.—Cenco News Chats, 32 pages, on "Tensiometers" for measuring surface and interfacial tensions of liquids as electrical insulating oils, detergents, shaving creams, etc.; vapor pressure bombs for testing gasoline, benzol, blends and other volatile, nonviscous petroleum products; gloss tester for measuring surface gloss of papers; mercury purifiers; new portable pH meter for field or laboratory use; oil plumb bob for gaging tank oils; indicator for determining content of entrained air in freshly mixed concrete; and other laboratory apparatus items. Request CNC 74.

155 DRAWING PENCILS

A. W. Faber-Castell Pencil Co., Inc.—Sample of any degree of Castell you desire complimentary is the best way to prove the established superiority of this superb drawing pencil. Positive accurately graded leads and greater blueprint reproductivity will be proved to you by actual tests.

156 HORIZONTAL END SUCTION PUMPS

Peerless Pump Div.—Food Machinery & Chemical Corp.—Bulletin B-2300 describes complete line of horizontal end suction general purpose pumps available in close coupled electric and belted models. Handle capacities up to 5500 gpm and heads to 260 ft. Motor sizes are available from ¼ to 150 hp. Compact, efficient, durable, and versatile pumps for water and alkaline fluids.

157 HYDRAULIC TURBINES

James Leffel & Co.—Two new bulletins tell about recent Leffel hydraulic installations. Bulletin No. 1083 describes the Leffel installation at the Bureau of Reclamation's new Anderson Ranch Dam, with photos, statistics, etc. Bulletin No. 1086 contains information on a Leffel turbine used in the expansion of TVA's Wilbur Dam, with photos, field-test results, cross-section of installation, etc.

For Consulting Engineers Turn to Page 150

What do you know about the *Moly-sulfide* LUBRICANT?

You may have heard rumors of a highly successful solid-film lubricant which is giving remarkable results in the shop and in the field.

In one 40-page booklet we have collected 154 detailed case-histories describing how difficult lubrication problems have been overcome by molybdenum sulfide. If you wish to be up to date about this solid-film lubricant, write for a free copy now.

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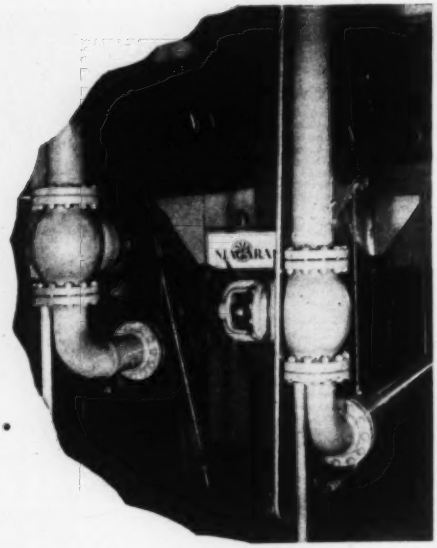
How to get drier or cooler gases . . .



NIAGARA AERO AFTER COOLER cools a compressed gas, or air, below the temperature of the surrounding atmosphere, thus preventing the condensation of moisture in your lines. The gas will contain only half of the moisture left in it by conventional methods. Even drier gas can be produced if you require it.

In working with controlled atmospheres of inert gases to prevent undesired reactions, this dryness of the gas at low cost is a great advantage. The cost of the Niagara method is low because it uses evaporative cooling, saving 95% of the cost of cooling water (and its piping and pumping). This direct saving of cost pays for the Niagara cooler in less than two years.

If you use compressed air to operate tools or pneumatic equipment you save much in water and oil damage to tools and equipment, and in water damage to materials by using the Niagara Aero After Cooler.

Write for a bulletin, or ask nearest Niagara Field Engineer if you have a problem involving the industrial use of air.

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Experienced Field Engineers in Principal Cities of U. S. and Canada

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158 WELDING FITTINGS AND STEEL FLANGES

Tube Turns, Inc.—Chart of Pipe and Fittings Materials. Quick-reference chart covering ASTM and other specifications, chemistry, service temperature limits and welding data on carbon, intermediate alloy, stainless and special analysis steels. Dimensional Data and Weights. Folder of man-size tables giving dimensional information on Tube-Turn welding fittings from $\frac{1}{2}$ to 30 in. in standard weight and extra strong, and flanges in all sizes and weights. Allowable working pressures. Booklet of pressure tables covering complete line Tube-Turn welding fittings for power piping, oil piping, heating piping, gas piping, refrigeration piping.

159 AUTOMATIC CONTROLLERS

Foxboro Co.—Bulletin No. 381 presents the many unusual features of the model 40 controller, and shows the various available types of this well-known member of the extensive Foxboro line of industrial instruments. Other bulletins cover individual subjects including indicating, recording, and controlling instruments of different kinds, whether pneumatic, electric, or electronic.

160 SNOW MELTING SYSTEMS

A. M. Byers Co.—A study of 50 snow melting systems operating in 15 divisions of business and industry in 17 states, is published in a 36-page bulletin. It traces the growth of the systems from the first recorded installation in the United States in 1925 through hundreds of installations of the past six years.

161 SK EQUIPMENT

Schutte & Koerting Co.—New products list folder, entitled "Index of SK Equipment and Descriptive Bulletins," lists SK products according to application and alphabetically, together with the numbered descriptive bulletin pertaining to each product.

162 CENTRALIZED LUBRICATION

Farval Corp.—Bulletin No. 25 provides a complete explanation of the Farval Dualine system of centralized lubrication and its advantages as a means of saving oiling labor, lubricant, bearing expense, and production time for various types of heavy industrial equipment. Its 16 pages liberally illustrated with photographs, drawings, and diagrams.

163 TUBE-SUPPORTED WALLS

Bigelow-Liptak Corp.—12-page 2-color catalog on tube-supported walls for industrial boilers describes in detail how Bigelow-Liptak walls may be suspended directly from boiler tubes with resulting savings in steel and erection time. Engineering drawings show typical jobs and describe how the enclosure is fastened to the boiler tubes.

164 FELT WICK LUBRICATORS

Miller Felpax Corp.—Catalog No. F-52 covers complete line of standard Felpax lubricators for railroad and industrial applications. Complete information on the care and maintenance of felt wick lubricators is included.

165 CRANE TRUCKS

Baker Industrial Truck Div., Baker Raulang Co.—Bulletin 1613 describes Baker model CXB and CXF locomotive-type crane trucks. Model CXB has a rated capacity of 6000 lb at 7-ft radius. Model CXF's rated capacity is 10,000 lbs at $5\frac{1}{2}$-ft radius. Complete engineering specifications and drawings are included, along with action photographs that show these trucks at work in a variety of applications.

166 TEFLON GASKETS

Flexitallic Gasket Co.—Folder gives properties, applications, construction features, and advantages of Flexitallic spiral-wound gaskets filled with Teflon. Illustrates how Teflon is trapped between edges of metal to prevent cold-flow after bolting load is applied. Shows how the flexibility of the gasket structure assures safe, efficient sealing, prevents leakage and contamination, and eliminates the necessity of frequent gasket replacement.

167 VIBRATION CONTROL

MB Mfg. Co.—Products for the detection, reproduction, and isolation of vibration are described in bulletin 410. Booklet contains helpful design data on vibration control, plus information on Isomode pad, Isomode units, and details on MB vibration exciters and test equipment.

168 ROLLER CHAINS AND SPROCKETS

Diamond Chain Co., Inc.—A new 112-page engineering catalog No. 649 containing complete informa-

tion on roller chains and sprockets for industrial power transmission is offered. Engineering information relative to the application of roller chain drives is presented.

169 STEAM TRAPS

Clark Mfg. Co.—Information is available on a new development in steam trap construction, called Duo-Step Leverage. By using an ingenious double-fulcrum point and venting mechanism it is now possible to increase the drainage capacity of a trap so that it may handle twice the condensate formerly possible.

170 SELF-ALIGNING COUPLINGS

Koppers Co., Inc.—Fast's Coupling Dept.—Six-page folder on Fast's self-aligning couplings gives graphic illustrations of principles and features of these couplings, table of utility factors for various kinds of connected machines, and tables of rating for standard forged-steel couplings and heavy-duty-type couplings.

171 HEAT EXCHANGERS, EVAPORATORS, FEEDWATER HEATERS

American Locomotive Co., Alco Products Div.—Catalog No. AL-3, 16-page general catalog, describes Alco's products and manufacturing facilities, including data and illustrations on conventional, multipurpose, and air-cooled heat exchangers; evaporators, feedwater heaters, pressure vessels, prefabricated piping, and welded steel pipe. Construction and application of patented flex-tube evaporators are described and illustrated, together with selection data on heat exchangers.

172 CUTTING FLUIDS

D. A. Stuart Oil Co.—A reliable guide to better machining through proper selection and application of cutting fluids is offered. Contains handy chart which aids in selecting cutting fluids for various metal-working operations. Two articles—"Mechanisms of Metal Cutting" and "Chemistry of Cutting Fluids" will help the shop man to better understand cutting-fluid functions and enable him to obtain more efficient operation.

173 OIL MIST PRECIPITATOR

Trion, Inc.—Catalog E-50 describes in full the purpose, principle of operation, construction features, and application of new oil mist precipitator specifically designed to meet the requirements of industry for the elimination of coolant oil mist and smoke emanating from high-speed cutting, grinding, and machining operations. This oil mist and smoke presents a health and safety hazard to plant workers unless properly collected.

174 UNFIRED PRESSURE VESSELS

Downingtown Iron Works—A partial analysis of the 1950 ASME Code for Unfired Pressure Vessels compared with the 1949 Code has been prepared by the Downingtown Iron Works. In addition to the comparison there are data on the facilities and manufacturing equipment and the welding procedure qualifications of the Downingtown organization.

175 VIBRATORY MATERIALS HANDLING EQUIPMENT

Syntron Co.—Catalog No. 519, 44-pages, illustrates and describes complete line of equipment, including bin vibrators, vibratory feeders, weighing and batching feeders, long conveyers, shaft seals, and power tools.

176 ELECTRIC MEASURING INSTRUMENTS

Westinghouse Electric Corp.—Booklet B-4696 covers the most complete line of electrical measuring instruments in the industry—portable, panel, switchboard, socket, and recording—for measuring all electrical quantities. This fully illustrated booklet also tells how to select, apply, and order Westinghouse instruments.

177 FLOWMETER

Hays Corp.—The new Hays Diaflow Meter is designed and engineered to measure air flow, gas flow, and the ratio of air flow to gas flow. Ideally suited for industrial furnaces, sewage disposal plants, and cost accounting. Employs pilot method of operation; dry diaphragm-type measuring element; package unit construction; complete data in bulletin 51-1017-37.

178 REPRODUCTION MATERIALS FOR ENGINEERING

Eastman Kodak Co.—A line of photographic materials for engineering drawing reproduction is described in a new Booklet, "Modern Drawing and Document Reproduction with Kodagraph Reproduction Materials." Of particular interest to engineers are three direct-to-positive printing room-

MEASURE IN MICROINCHES RMS

By 3 to 2
it's a shop tool!

The Profilometer at National

At the National Cash Register Company plant in Dayton, Ohio, Profilometers used as shop tools outnumber those in inspection three to two.

For example, the Profilometer shown is on *actual* production work in a machining department. Here, the surface finish of a bearing in a side frame of a cash register is being checked. Reaming specifications call for the bearing surface to have a rating of 20 microinches or less.

Other Profilometers are used as shop tools in two parts-machining departments. Still others are used in tool inspection and in investigation-inspection. The latter section—with the help of the Profilometer—determines if the engineering specifications for surface finish are being met.

Extreme accuracy has always been stressed in the more than 180,000 different parts that go to make up National Cash Register accounting machines and adding machines. Because of that policy, the National Cash Register Company was one of the original purchasers of a Profilometer. That investment has paid off many times.

If accuracy in surface roughness measurement is important in your plant, the Profilometer can give it to you.

To learn how the Profilometer can help cut costs in your production, write today for these free bulletins.

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Flexible ALL METAL COUPLINGS

FOR POWER TRANSMISSION REQUIRE NO MAINTENANCE

Patented Flexible Disc Rings of special steel transmit the power and provide for misalignment and end float.

Thomas Couplings have a wide range of speeds, horsepower and shaft sizes:

½ to 40,000 HP
1 to 30,000 RPM

Specialists on Couplings for more than 30 years

BACKLASH FRICTION WEAR and CROSS-PULL are eliminated

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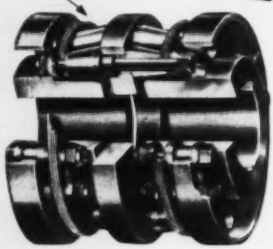
PATENTED FLEXIBLE DISCS



THE THOMAS PRINCIPLE GUARANTEES PERFECT BALANCE UNDER ALL CONDITIONS OF MISALIGNMENT.

NO MAINTENANCE PROBLEMS.

ALL PARTS ARE SOLIDLY BOLTED TOGETHER.

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THOMAS FLEXIBLE COUPLING CO.
WARREN, PENNSYLVANIA

light-handling materials. Kodagraph Autopositive Paper, Kodagraph Autopositive Film, and Kodagraph Autopositive Cloth, which have valuable applications for making intermediates. They can be exposed with conventional drafting-room equipment.

179 OIL BURNERS

Ray Oil Burner Co.—A condensed 16-page catalog in color, with illustrations, capacity table, and listing the company's commercial and industrial oil and combination gas-oil burners, including: fully automatic, semiautomatic, and manually controlled horizontal rotary types and steam turbine drive; commercial and domestic pressure atomizing types for oil or combination gas-oil.

180 HIGH-TEMPERATURE STEELS

U. S. Steel Subsidiaries—Catalog gives a detailed discussion, supplemented with photographs, drawings, charts, and tables, covering the properties and characteristics of steels in high temperature service.

181 AIR CONDITIONING

Sturtevant Div., Westinghouse Electric Corp.—Equipment for air conditioning, air handling, and air cleaning is described. Features, specifications, and descriptive material on air conditioners, unit heaters, home electronic air cleaners, hermetically sealed compressors, and condensers and water coolers are included.

182 STEAM TRAP PROBLEMS

V. D. Anderson Co.—Bulletin No. 151 entitled "Solving Steam Trap Problems," contains 36 pages of illustrations, drawings, and charts, describing the importance of trap selection and showing application for various industries.

183 TANKS AND TOWERS

W. E. Caldwell Co.—New 50-page catalog No. 58 with illustrations, data, and prices on wood and steel tanks and towers for all purposes, as well as tank agitators, stirring devices, tank heaters, float valves, and many other accessories of all kinds.

184 CENTRIFUGAL PUMPS

Dean Bros. Pumps Inc.—New 16-page Centrifugal Pump Instruction Manual includes instructions for installing, operating and maintaining special and general service centrifugal process pumps, liberally illustrated with photographs, drawings and sections. A new four page circular completely describing industrial process pumps for special application is also available.

185 MATERIALS HANDLING

Clark Equipment Co.—The most efficient means of having what is needed, where it is needed, when it is needed, is the core of good materials handling, and frequently means the difference between profit and loss in manufacturing and processing operations. This basic subject of time-and-place utility is thoroughly covered with pictures and captions in a recent issue of "*Material Handling News*." Copies of this and new issues available.

186 SPREADER STOKERS

Detroit Stoker Co.—Bulletin No. 890 describes a spreader stoker having overthrow rotors that provide exceptionally uniform fuel distribution. Available with stationary, hand-dumping, and power dumping grates. Many sizes assure efficient application to all types of boilers and steam generators. Burns all grades of bituminous coal, lignite, and various kinds of wood, and other refuse.

187 DRAFTING ROOM EQUIPMENT

Hamilton Manufacturing Co.—Drafting equipment is described in Hamilton catalog No. 13-S. Auto-Shift tables with instant adjustment for height and slant from horizontal to vertical; tracing files with patented tracing lifter, making every sheet a top sheet; and a complete line of files and drawing tables to meet all requirements.

188 FLY-ASH COLLECTION

Research Corp.—Bulletin No. FA, entitled "What's New in Fly Ash Collection," discusses problem, particle size analysis, efficiencies, new developments, and engineering features of Research Corp. electrical precipitators for this service. Continuous rapping and automatic voltage control equipment described.

189 COMPRESSOR CHECK VALVE

Pennsylvania Pump & Compressor Co.—Bulletin No. 509 M features five distinct advantages provided by the installation of the PPC Aircheck valve in the discharge line of an air or gas compressor. Noisy discharge line made quiet with Aircheck.

190 MECHANICAL SOOT BLOWERS

Hahn Equipment Corp.—Four-page catalog with supplements, describes and illustrates the fixed-nozzle-type soot blower, that will positively clean each tube end to end. Operation requires about one minute with either steam or compressed air.

191 TECHNICAL BOOKS

Lefax Publishers—Over 2000 listings of Lefax pocket-size technical books are contained in the newly revised 1952 Lefax list of technical data sheets. Condensed, mathematically accurate source materials for engineers, construction men, technical workers, and technical students. Each book consists of approximately 140 pages of easily read tables and data in pocket size, loose leaf form for handy reference right on the job.

192 WATER SOFTENERS

Graver Water Conditioning Co.—Catalog WC-102 entitled "Hot Process Water Softeners" contains 35 pages of data, photographs of typical installations, flow diagrams, plant layout drawings, and results. In addition to features of design and operation, information is given pertaining to hot zeolite softening, automatic desludging systems, filter wash water collection and chemical feeders, as well as full descriptive data and illustrations of accessories employed.

193 MICROMATIC MICROHONING

Micromatic Hone Corp.—Cross Hatch, a bi-monthly publication describing and illustrating the fundamentals of the Microhoning process. Each issue graphically presents the full story of one type of equipment or application. Photographs of equipment in actual operation are given with the complete story of the accomplishments. Back issues are available.

194 CONNECTIVE COUPLINGS

Hansen Mfg. Co.—New catalog is composed of various loose leaf bulletins, each of which incorporates complete information, engineering data, dimensions, etc., pertaining to any particular type of Hansen coupling, such as straight through, one-way shut-off, or two-way shut-off—or special service couplings for oxygen, acetylene, gasoline, steam, or other applications.

195 AUTOMATIC BURNERS

Peabody Engineering Corp.—The Peabody automatic burner unit is described in a new bulletin. Developed for pumping, heating, and burning heavy fuel oil it employs the identical wide range mechanical, pressure-atomizing method used exclusively in the nation's largest power plants. At such installations, economies are calculated in fractions of a percentage point.

196 BITUMASTIC PROTECTIVE COATINGS

Koppers Co., Inc.—Informative package of six bulletins covers (1) Bitumastic Hi Heat gray for high-temperature corrosion prevention; (2) Bitumastic Black Solution for general, low-cost maintenance; (3) Bitumastic Super-Service Black, heavy-duty coating for more severe conditions; (4) Bitumastic No. 50, extra heavy-duty coating for extremely severe corrosive conditions; (5) Bitumastic No. 28, heavy-duty coating for atmospheric corrosion control; (6) Bitumastic Tank Solution, quick drying, useful for water tanks, air conditioning equipment, etc.

197 AIRCRAFT CONTROL BEARINGS

Shafer Bearing Corp.—Fully illustrated catalog devoted exclusively to the Shafer line of aircraft roller bearings which are available in a full-size range of standard (specials to order) self-contained, single-row, double-row, and rod-end types for all conventional control applications for all types of air-borne craft. Contains complete specifications, engineering and application data and relative merits of the basic Shafer ConCaVex design which employs concave rollers and convex races.

198 STEEL ROLLING GRILLES

Kinnear Mfg. Co.—Revised 8-page bulletin No. 21-A describes all metal rolling grille that provides an attractive barricade for openings, such as hall-

GIVE

- and give generously

ways, doorways and windows. Operating like a rolling door, it can be arranged for complete concealment above the opening when raised. Gives details, clearance requirements and available accessories.

199 VERTICAL CENTRIFUGAL PUMPS

Lawrence Pump & Engine Co.—"Vortex"—not just a sump pump! Whenever your industrial pumping problem concerns a vertical unit, either dry pit or wet well installation, consult "Vortex" engineers for your best answer. Write for bulletin on "Vortex" Vertical Pumps.

200 SPREADER STOKERS

Detroit Stoker Co.—Bulletin No. 80 describes improved-type spreader stoker, having a forward moving grate that slowly and continuously discharges ash at front. Has uniform fuel distribution, high burning rates, and burns all grades of bituminous coal or lignite, wood, and refuse. Thermal efficiency is exceptionally high—either with steady or fluctuating loads.

201 VALVES, TRAPS, AND VENTS

Marsh Heating Equipment Co.—Catalog 76-H describes a complete line of radiator valves, radiator traps, steam traps, and air vents. Each item is illustrated and fully described. Included are capacity charts and line drawings showing roughing in dimensions. Also included are diagrams showing typical heating installations with the position of valves, traps, and vents clearly indicated. In addition bulletin S-750 "Manual of Temperature Regulation" is included with each catalog.

202 AIR HANDLING, COMFORT CONDITIONERS, COOLING TOWERS, ETC.

Bush Mfg. Co.—Catalog No. 425 contains engineering information, descriptions, and specifications covering Bush air handling units, coils, comfort conditioners, cooling towers, and evaporative condensers. Includes full engineering and selection data. Bulletin 525 covers finned radiation and Bulletin 545 covers convectors for heating.

203 CRUSHERS

American Pulverizer Co.—Bulletin illustrates and describes in detail complete line of custom-built crushers, grinders, shredders, and choppers for uniform reduction. Includes cutaway and cross-sectional views as well as engineering data and specifications.

204 ELECTROPLATED PIPE, TUBING, FITTINGS

Bart Mfg. Corp.—A new folder covers the Bart Lectro-Clad Process for developing a smooth, ductile pore-free nickel deposit fully adherent to the base metal of pipe, tubing, etc. Especially useful to those confronted by corrosion or contamination problems.

205 VARIABLE SPEED DRIVES

Reliance Electric and Engineering Co.—Bulletin D-2311 covers features of the Reliance variable speed drive. Components included are (1) the operator's control station, (2) the adjustable speed motor, (3) the control unit.

206 GEARS, ETC.

Boston Gear Works—Catalog No. 55 gives complete information and prices on over 4,500 stock items including spur, miter, bevel, helical, and worm gears, roller chains, sprockets, ball bearings, pillow blocks, couplings, pulleys, speed reducers, ratiomotors, and oil-impregnated porous bronze bearings. It provides engineering data, formulas, horsepower rating charts, reference tables, and selection charts for figuring the correct power drive and selecting the proper equipment for virtually every mechanical power transmission.

207 ACCELEROMETERS, DIFFERENTIAL TRANSFORMERS

Schaevitz Engineering—Bulletins are available on the following: No. E-1-1 on Rotary Accelerators, Nos. A-1-1, A-1-2, A-1-3, A-1-4, A-1-5, A-1-6, A-1-7, and A-1-8 on Linear Variable Differential Transformers.

208 FLEXIBLE COUPLINGS

Lovejoy Flexible Coupling Co.—Illustrated Catalog with Selector Charts. Grouping and application of L-R Flexible Couplings. Describes and pictures various types of couplings, with cutaway views and diagrams. New couplings for d-c standard mill motors. Selector Charts make it easy to choose correct type and size of coupling with proper cushion material for application.

209 SOLENOID PILOT VALVES

Valvair Corp.—A new 8-page illustrated bulletin "P" describes a new Valvair solenoid pilot valve for controlling air, vacuum, oil, and water. Mechanical drawings show 2-way, 3-way, and 4-way, single and double models, with exhaust port plugged, for manifold mounting and for other applications. Complete parts are listed for all models, together with parts numbers and designations on drawings.

210 FIN-TYPE RADIATION

Warren Webster & Co.—A 16-page bulletin gives engineering data with dimensions, ratings, and technical description of Webster Walvector, fin-type radiation utilizing copper tubes, aluminum fins, and pressed steel enclosures. Also describes Webster perimeter heating, a method of application of this type of radiation for the heating of buildings which is proving instrumental in reducing building heating cost.

211 LUBRICATION

Lubriplate Div., Fiske Bros. Refining Co.—Newly revised 56-page Lubriplate Data Book contains much valuable information on the subject of lubrication and includes product description and correct recommendations for machinery in all industries.

212 PRESSURE GROUTING INFORMATION

Gardner-Denver Co.—Bulletin P-60 contains pressure grouting information, construction details of the Duplex high-pressure steam pumps for grouting service, stationary air compressors, and hand held drills. Supplemented with charts, diagrams, and illustrations, and other informative matter.

213 MOTOR BASE

Lovejoy Flexible Coupling Co.—Illustrated catalog sheet on new tilting motor base for fractional hp motors, gives full description and specifications for low-priced adjustable motor base. Besides its use with variable speed pulleys, it also acts as a belt tightener.

214 TECHNICAL BOOKS

John Wiley & Sons—Publishers of scientific and technical books. 1952 catalog available, containing descriptions of over 1300 books in science and engineering. Of particular interest to engineers are the following recently published Wiley titles: Morse & Kimball's "Methods of Operations Research," Mallick & Gaudreau's "Plant Layout," MacNiece's "Production Forecasting, Planning & Control," Chestnut & Mayer's "Servomechanisms & Regulating System Design," Parker's "Simplified Mechanics & Strength of Materials," Chalmers' "Structure and Mechanical Properties of Metals," and Farrington's "Fundamentals of Automatic Control."

215 TUBING

Bundy Tubing Co.—New 20-page booklet, in color, contains technical data and fabricating information on Bundyweld steel (copper or tin-coated) tubing of particular interest to production and design engineers in metalworking industries.

216 AIR CONDITIONING AND REFRIGERATION

Frick Co.—A new 8-page folder summarizes the refrigerating equipment made by this Pennsylvania firm, which will celebrate its 100th Anniversary next year. Bulletin 29-A includes a thermometer of refrigeration temperatures and services; a list of branch offices, with phone numbers and managers' names; and complete pages devoted to Freon Refrigeration; unit air conditioners; air-conditioning systems; ammonia refrigeration; coolers for air, water, brine; and condensers, control equipment, valves and fittings. The folder is illustrated with dozens of photographs, tables, etc.

217 VALVES

Lunkenheimer Co.—"Lunkenheimer Guide" is an illustrated, thumb-indexed catalog of representative Lunkenheimer valves—iron, steel, and bronze—in all pressure classes. Also gives complete information on Lunkenheimer boiler mountings and

All These Were Once

DUST COLLECTION PROBLEMS, TOO

48 Carbon Black Plants
203 Metallurgical Installations
205 Acid Plants • 40 Paper Mills
270 Delarring Installations
216 Power Stations
73 Steel Plants • 99 Oil Refineries
and Miscellaneous Installations

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HORTON ALUMINUM TANKS

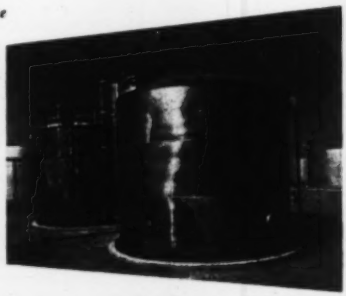
Storing Acetic and Propionic Acids at Large Texas Chemical Plant

The five Horton* aluminum tanks shown above are used to store acetic and propionic acids at a large Texas chemical plant. Aluminum has the advantage of not promoting oxidation of these compounds and it resists corrosion. Aluminum is also non sparking and it can improve temperature control through its high conductivity.

Fabricating and erecting storage tanks and processing structures from aluminum and other corrosion-resistant alloys is one of our specialties. Years of experience enables us to tackle most tank construction problems with complete confidence.

Write our nearest office for more complete information, estimates or quotations. There is no obligation on your part.

* *Registered in U. S. Patent Office*



Above: Three 35-ft. in diam. by 18-ft. acetic acid tanks and two 23-ft. in diam. by 18-ft. propionic acid tanks of aluminum construction.

Right: Two 50,000-gal. Horton aluminum tanks storing propionic acids at a chemical plant in Texas.

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Atlanta 3.....2113 Healey Building
Birmingham 1.....1566 North 50th Street
Boston 10.....1081—201 Devonshire Street
Chicago 4.....2466 McCormick Building
Cleveland 15.....2240 Guildhall Building
Detroit 26.....1511 Lafayette Building
Houston 2.....2136 C & I Life Building
Los Angeles 17...1518 General Petroleum Building
New York 6.....3301—165 Broadway Building
Philadelphia 3.1618—1700 Walnut Street Building
San Francisco 4.....1356—200 Bush Street
Seattle 1.....1321 Henry Building
Tulsa 3.....1610 Hunt Building
Washington 6, D.C. .....1143 Cafritz Building

Plants in: BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PA.

CATALOG GUIDE

lubricating devices. Includes information for selecting and specifying hundreds of popular Lunkenheimer valves.

218 BOILERS AND RELATED EQUIPMENT

Babcock & Wilcox Co.—Bulletin G-76 describes the B&W integral-furnace boiler type FM, a completely shop-assembled boiler for unit shipment, available in standard sizes for load ranges from 2900 to 28,000 lb of steam per hr at pressures up to 250 psi. Details of design, construction, installation, and operation are discussed and illustrated.

219 VIBRATION FATIGUE TESTING MACHINES

All American Tool & Mfg. Co.—Catalog No. F, 12-pages, describes all models—vertical and horizontal table motion—manual or automatic control. Outlines application. Gives handy nomograph and list of users.

220 TURBINE PUMPS

Deming Co.—A 24-page bulletin No. 4700 includes description of vertical turbine-type pumps, their construction, types of heads, and power drives. Uses include general water supply, sump service, condensate return service, gasoline and fuel oil pumping, and solvent pumping service.

221 HELICAL GEAR SPEED REDUCERS

Foote Bros. Gear and Machine Corp.—Manual LPB illustrates, describes, and contains complete application data on Line-O-Power straight-line helical gear speed reducers. This new line features Duti-Rated high hardness precision helical gears assembled into rugged cast housings of streamlined design. These drives are available in double or triple reductions with ratios up to 238 to 1 for capacities up to 178 hp.

222 CAST STEELS

Lunkenheimer Co.—A 52-page brochure discussing Lunkenheimer cast steels describes their manufacture, properties, and applications in a simple and nontechnical manner. Also included is a discussion of today's basic problems; the manufacture and test of valves; the properties of the various classes of cast steels; ASME code rules, and a glossary of engineering terms in connection with cast-steel valves.

223 LIQUID METERS

Neptune Meter Co.—New 20-page bulletin describes meters for handling over 100 industrial liquids in processing, batch mixing, cost control operations. Includes Auto-Stop meter with automatic quantity control for accurate formulas. New meter-selector charts give complete selection and specification data for over 30 different liquid meters. Capacities from 2 to 1000 gpm, temperatures to 250 F, pressures to 500 psi.

224 STEEL SHAPES AND SHELLS

Pressed Steel Tank Co.—New bulletin illustrates pressed steel shapes and shells; shows pressed steel shells and shapes used in so many applications—many times replacing welded tubing, cast steel parts; eliminating necessity for expensive machining.

225 LUBRICATED PLUG VALVES

Homestead Valve Mfg. Co.—Reference Book 39-5 contains complete information on the expanded Homestead-Reiser lubricated plug valve line. Catalog includes valve cross-sectional views, photographs, dimensions, and information for ordering. In addition, complete specifications are given for the new venturi-type, worm-and-gear controlled, steam-jacketed bonnet, and three-wave valves, all recently added to the line.

226 BLOWERS, EXHAUSTERS, PUMPS, ETC.

Roots-Connersville Blower Corp.—Regularly issued individual bulletins covering centrifugal blowers and exhausters; rotary positive blowers, gas pumps, liquid and vacuum pumps; positive displacement meters, and inert gas generators.

227 SLUSH MOLDINGS

Watson-Standard Co.—Reprint of an article concerning Slush Moldings with Plastisols discusses recent uses of vinyl plastisols in the production of rubberlike flexible molding to replace rubber in many applications. Techniques of slush-molding are included together with a discussion of the physical properties obtained in the process. Some advantages include eliminating the necessity of two-part mold and reduction of finishing expense by obviating the presence of a parting line.

228 STEAM TURBINES

Terry Steam Turbine Co.—Bulletins in looseleaf form which cover a complete description of Terry solid wheel turbines with cross section drawings of

typical units for both moderate and high steam pressure conditions: a description of the Terry axial flow impulse, both single stage and multi-stage; Terry gears which are used for speed increasing and speed reducing.

229 FLEXIBLE CONTROLS

American Chain & Cable Co., Inc.—"Key to Remote Control," DH-287, is a 12-page 8½ x 11-in. booklet describing Tru-Lay Push-Pull flexible controls which provide a means of transferring push and/or pull movements from one location to another. Illustrates how the Tru-Lay Push-Pull is constructed, how it functions, the five sizes, standard bracket type, and special purpose heads and sliding sleeve and special terminals.

230 ELECTRIC MOTORS

Delco Motors Div.—An 8-page bulletin illustrating Delco fractional horsepower motors, Delco single-phase general-purpose motors, Delco single-phase definite-purpose motors, Delco industrial motors, and Delco polyphase industrial motors. Featured is a cutaway showing exclusive Delco features.

231 VALVES

Hays Mfg. Co.—Bulletin No. 117 discusses the Hays "Electrofio" valve for appliances and industrial equipment. The Electrofio valve is used for the control of water, oil, steam, and air. Cutaway drawings illustrate the several models. Three selections of piping methods are illustrated.

232 MATERIALS-HANDLING EQUIPMENT

Clark Equipment Co.—Condensed catalog contains basic specifications of Clark line of materials-handling equipment, including fork-lift trucks, both gas-powered and electrics, on solid tires and pneumatic tires; industrial towing tractors; hand trucks and hand stackers, both gas and electric; and the complete line of 20 special attachments designed for particular needs.

233 STAINLESS-STEEL SHEET AND STRIP

Washington Steel Corp.—A new bulletin describes MicroRold stainless-steel sheet and strip, produced by the Sendzimir process of continuous cold reduction. Physical properties, specifications, standard type numbers, and analysis of MicroRold stainless are included. Featured by type number is a discussion of the application and uses of each type of MicroRold.

234 PRECISION DEEP DRAWING

Hydropress, Inc.—"Better Form with Marform" is the title of a new 12-page folder on the Marform precision deep-drawing process and its equipment. Many illustrations.

235 FLEXIBLE COUPLINGS

American Flexible Coupling Co.—Catalog 501 contains 12 pages of technical data on flexible couplings and features the "Amerigear" and "American" couplings. Includes specification data, cutaway drawings, and plan drawings, together with rating tables, construction features, and dimension factors.

236 HIGH-PRESSURE COMPRESSORS

Norwalk Co., Inc.—Catalog No. 40 describes high-pressure compressors of all types—from one to six stages up to 25,000 lb pressure—for all different types of gases. Also described are special compressors built to customer's specifications. A feature is a check list to save the customer's time when inquiring or ordering compressors.

237 REFRACTORIES

Harbison-Walker Refractories Co.—A new bulletin on the smooth working, super duty Silica cement for use in laying refractory silica brick. Developed especially for use with Vega super-duty silica brick. This cement contributes materially to superior furnace performance and life in such furnace applications as open-hearth, electrical-steel, heating, glass-tank, copper reverberatory, copper-refining, and nickel-refining furnaces.

238 SELF-LOCKING PIN FASTENER

Elastic Stop Nut Corp. of America—Completely new 16-page Rollpin Catalog tells how the Rollpin is used to replace set screws and rivets, to pin or key gears, pulleys, levers, knobs; as locating dowels, stop pins, or shafts for small gear trains. Catalog is illustrated with application pictures and stories and contains exacting engineering data; recommended hole sizes, insertion and removal forces, wear resistance and strength figures. Standard diameters and lengths listed and marked as to their availability.

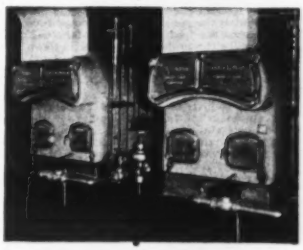
239 WELDING USES

Lincoln Electric Co.—A series of bulletins reviewing basic engineering data relevant to the design of

Santa Rosa Hospital Built for Reliability . . .
and Selected

KEWANEE
HEAVY-DUTY BOILERS

SANTA ROSA HOSPITAL, San Antonio, Tex.
PHELPS, DEWEES & SIMMONS, Architects
GUARD M. BAKER, Engineer
JUD PLUMBING & HEATING CO., Heating Contractors



By specifying Kewanee Heavy-Duty Boilers, for 100, 125 or 150 pounds working pressure, large institutions can be certain of dependable heat at all times with an ample reserve for emergencies . . . *plus high pressure steam* for kitchens, laundries, sterilization and other equipment.

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You can install Williams-Hager flanged Silent Check Valves in your water system in any position . . . horizontal, angular, vertical with flow upward or downward . . . and put an end to costly and annoying water hammer. Easy to install or reseat without special tools, they are durable and compact with easy accessibility and low friction. Available in standard pipe sizes from 1" to 20". Investigate the many features of these valves . . . and save!

CHECK VALVES

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Write today for your copy of this informative bulletin on Water Hammer, its Cause, Effect and Control in Piping Systems.

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BUYER'S CATALOG GUIDE

machinery in steel. Tells how to use steel for maximum efficiency and how to weld for lowest cost manufacturing; makes possible savings up to 50 per cent of the cost of an unmachined product, reduction of 30 per cent in weight, and ability to provide greater rigidity.

240 STEEL VALVES

Wm. Powell Co.—Catalog No. 102 summarizes the broad line of Powell cast-steel valves. Included are bolted flanged bonnet valves, class 150 lb to class 2500 lb inclusive, and pressure seal valves, classes 600, 900, 1500, 2500 lb and higher. Containing more than 200 pages, the bulletin discusses the production facilities at Powell, the engineering service, large stocks in principal cities of the United States, vigilant laboratory control of metal heats, the chemical and physical properties of the various Powell cast steels, and specification data on each of a wide variety of valve classes.

241 NICKEL ALLOYS

International Nickel Co., Inc.—Standard Alloys for Special Problems is an illustrated 16-page booklet that describes in detail the mechanical and other properties of nickel, Monel, and other Inco nickel alloys. It lists the mill forms in which these materials are produced as well as applications for which they are especially suited.

242 ELEVATED STEEL TANKS

Chicago Bridge & Iron Co.—A 24 page booklet, "Horton Elevated Steel Tanks of Large Capacity," describes the advantages of using large elevated steel tanks to provide gravity pressure in municipal waterworks systems. It contains detailed information on the design and construction of Horton radial cone elevated tanks which are built in capacities from 500,000 to 3 million gal and Hortonspheroidal elevated tanks built in sizes from 1 million to 3 million gal. Included are 12 photographs of actual installations, a table of sizes, and a page of drawings showing construction details.

243 INDUSTRIAL ADHESIVES

Armstrong Cork Co.—"Armstrong's Adhesives for Industry," a 32 page manual describing the variety of adhesives for various applications as formulated by the Armstrong Cork Co. The booklet is also designed to help those who may not be intimately familiar with the subject to buy and use industrial adhesives to the best advantage, and to stimulate new ideas for the profitable use of adhesives.

244 DUST COLLECTION

Buell Engineering Co.—"The Collection and Recovery of Industrial Dusts," a 28-page brochure 101, explains what dust is, techniques in the analysis of dust, and factors which influence choice of collection equipment. Information on cyclone, electric precipitator, low resistance, and low draft loss collectors is presented. Combination systems, special purpose collectors, and hopper valves are also discussed.

245 REVERSING VALVE STEAM ENGINES

Soulé Steam Feed Works—"Steam Feed" booklet contains full description of twin-cylinder steam engine rated 16 hp with 100 lb steam at 300 rpm. Speed and direction of operation obtained by one throttle valve. Originally sawmill carriage feed engine, suitable for any use requiring these characteristics.

246 REPRODUCTION EQUIPMENT

Ozalid, Div. of General Aniline & Film Corp.—Catalog No. ME-1 describes the complete line of Ozalid's copying machines and sensitized materials. This circular points out how Ozalid cuts paperwork and costs by providing direct, ready to use copies of anything typed, written, printed, or drawn on translucent material. Specifications and illustrations of all machines; uses and properties of all materials.

247 GAGES AND THERMOMETERS

Marsh Instrument Co.—Catalog 76-1 describes in detail a wide line of quality industrial gages and thermometers. The catalog is fully illustrated including cutaway photographs and enlargements of internal parts. Covered also are gage accessories, specifications, including line drawings, dimensional tables, and templates covering every size and pattern.

248 METAL TURNINGS CRUSHERS

American Pulverizer Co.—Bulletin discusses value of crushed turnings in oil reclamation and scrap sale. Shows how to convert long metal turnings from a problem to a profit. Describes features, design, and construction of American crushers. Also lists approximate capacities, speeds, and power. Typical installations are shown.

249 INDUSTRIAL METER SELECTION

Rockwell Mfg. Co.—A new bulletin, No. OG-400, intended to guide the proper selection of meters for measuring more than 200 chemicals, petroleum products, and other liquids with varying corrosive characteristics is available. In addition to the complete table of metered liquids matched with case, chamber, and piston specifications, the bulletin also includes a simplified specification sheet which makes it easy for the customer to cover all necessary operating requirements so that proper meter recommendations can be made at the factory.

250 ELECTRIC MOTORS

Reliance Electric and Engineering Co.—Bulletin B-2101 gives construction features, selection data, prices, how to order, and dimensions of Reliance precision-built electric motors.

251 LEVER SEALD VALVES

Homestead Valve Mfg. Co.—Reference book 39-3 offers complete information on Lever Seald Valves made of brass, semisteel, cast steel, and other metals for specific service conditions. Specifications for these valves, which feature "stickproof" operation, are given in charts, with photos and line drawings illustrating each type valve. Also included in this 16-page catalog are on-the-job photos of Lever Seald Valves, illustrating their many uses.

252 BULK FLOW CONVEYERS

Link-Belt Co.—48-page book No. 2175, copiously illustrated, contains complete engineering data on the combination Bulk Flo elevator, conveyer, feeder consisting of an endless chain to which cross flights are attached at intervals, all contained inside a close fitting casing. Ideally suited for handling a variety of bulk flowable granular, crushed, ground, or pulverized materials.

253 NOZZLES, NECKS, FLANGES

Taylor Forge & Pipe Works—New Taylor Forge Catalog No. 501 describes and illustrates Taylor forge nozzles, welding necks, and large-diameter flanges. Also included are data covering standards of the Tubular Equipment Manufacturers Association (TEMA Standards). The Taylor Forge publication, Modern Flange Design, is also incorporated as a part of this catalog.

168 ROLLER CHAINS AND SPROCKETS

Diamond Chain Co., Inc.—A 112-page engineering Catalog No. 649 containing complete information on roller chains and sprockets for industrial power transmission is offered. Engineering information relative to the application of roller chain drives is presented.

255 VENTILATING FANS

Propellair Div. of Robbins & Meyers, Inc.—Latest catalog, Form 3238, describes uses of various types of Propellair ventilating fans such as tubeaxial, vaneaxial, Sky-Blast, belt-driven, pulley-driven, etc. Typical modern industrial applications of Propellair equipment are pictured.

256 CHRONOMETRIC TYPE TACHOMETER

Herman H. Sticht Co., Inc.—Bulletin No. 735 shows the new improved Jaquet speed indicator with new ball bearing spindle, and new dial with extra scale divisions which greatly increases readability. The guaranteed accuracy of these instruments is $\frac{1}{4}\%$. The bulletin shows four different models covering extreme low speeds with readings possible to 0.02 of 1 rpm per division in the Catalog 2304 model, and allowing maximum readings to be taken up to 100,000 rpm in the Catalog 2300 Velox Indicator.

257 TRACING PENCIL TEST KIT

American Lead Pencil Co.—Kit contains samples of Venus tracing pencils for testing on various types of papers. This new pencil contains an active chemical to produce clearer, sharper, white or blueprints when reproduction is made from a pencil drawing.

258 ROTARY LIQUID PUMPS

Kinney Mfg. Co.—Bulletin L51 describes the rotating plunger pump for handling viscous liquids, from asphalt to molasses, and the Heliquad rotary pump with rotors driven by timing gears for pumping fluids, from gasoline to hot oil or molasses. Capacity tables are included for 53 sizes up to 3000 gpm.

259 CENTRIFUGAL COMPRESSORS

Carrier Corp.—32 page book entitled, "Centrifugal Compressors for Industry," covers the application and advantages of centrifugal compressors in petroleum and chemical processes requiring compression of gases or refrigeration. Fully illustrated with

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diagrams, charts, and photos of installations, it also contains engineering data and simple selection methods.

260 ELECTRIC POWER DRIVES

Sterling Electric Motors, Inc.—A new catalog completely describing Sterling's line of variable speed, geared low speed, and constant normal speed electric power drives in drip-proof, splashproof, and totally enclosed designs. Outstanding features are interchangeable mounting dimensions between constant normal speed drives and variable speed drives, and protected, compact, self-contained construction.

261 SEAMLESS TUBE

Wolverine Tube Div.—A new 64-page 2-color catalog describes and illustrates seamless, nonferrous tubular products. Detailed explanation of specific measures taken to produce quality controlled products to meet the exacting demands of each tube application. All information and data based on many years of experience and tests made by Company's engineers in collaboration with other technical and professional personnel.

262 SOLENOID VALVES

Ruggles-Klingemann Mfg. Co.—Additional pages for catalog E on electrically operated valves now being printed showing new designs and typical applications. This catalog contains complete information for valves from $\frac{1}{4}$ to 12 in.

263 GRAPHITAR

United States Graphite Co.—Catalog G-49, 66 pages, illustrates and describes this carbon-graphite engineering material, "all carbon, nonmetallic, lighter than magnesium, harder than steel." Catalog contains charts, specifications, manufacturing and operating information, methods of assembly, 60 illustrated typical design applications such as seals, rings, pistons, bearings, collector wheels, blades, valve parts, etc., and the many industries where applicable, including oil, electrical, steel, chemical process, glass, textile, etc.

264 ELECTRONIC SCALE

Streeter-Amet Co.—Streeter-Amet, working with the Baldwin-Lima-Hamilton Corporation has created an electronic weight determination instrument. By use of electronic cells this new scale will record and print on ticket, tape or even a ledger, remote from the scale, the exact weight. A brochure explains the simplicity of construction, the low maintenance, and the ease of installation of this new scale.

100 BULK MATERIALS BIN-FLO AERATOR UNIT

Bin-Dicator Co.—4-page bulletin BF-1 with enclosures gives complete description and illustrations of unit; application data, typical layouts, air pressure consumption, supply and piping data, specifications, prices and installation instructions, and list of present users in 23 states. Simple low-cost device provides uniform and continuous flow of dry, finely ground materials from bins, hoppers, and chutes.

266 FASTENINGS

H. M. Harper Co.—New Price List and Stock Book covers complete line of nonferrous and stainless-steel fastenings. Containing 56 pages, the book is printed in color with every type of fastening shown in natural color. An index page lists all fastenings by alloy and type for fast easy reference. Included in the booklet are complete descriptions of all Harper Everlasting Fastenings carried in stock in brass, bronze, copper, Monel, aluminum, and stainless steel.

267 ELECTRICAL CONNECTORS

Titeflex, Inc.—A complete line of new lightweight electrical connectors is described. The new type connectors are designed to meet special requirements of temperature, corrosion, and vibration. The connectors will be furnished in 17 shell sizes, conforming to AN sizes 8-36 inclusive and can be furnished for cord connections, shielded assemblies, and bulkhead or box mountings.

268 THERMOSTATIC BIMETAL

W. M. Chace Co.—64-page reference manual to aid engineers in design of actuating elements for temperature-responsive devices. Contains applications of Chace thermostatic bimetal, elements of thermostat design, proper heat-treatment for bimetal, various formulas and calculations, descriptions of 30 bimetals with 30 full-page charts and data describing physical properties of each bimetal.

269 SILICONE PRODUCTS

Dow Corning Corp.—A reference guide to Dow Corning silicone products is a revised general catalog

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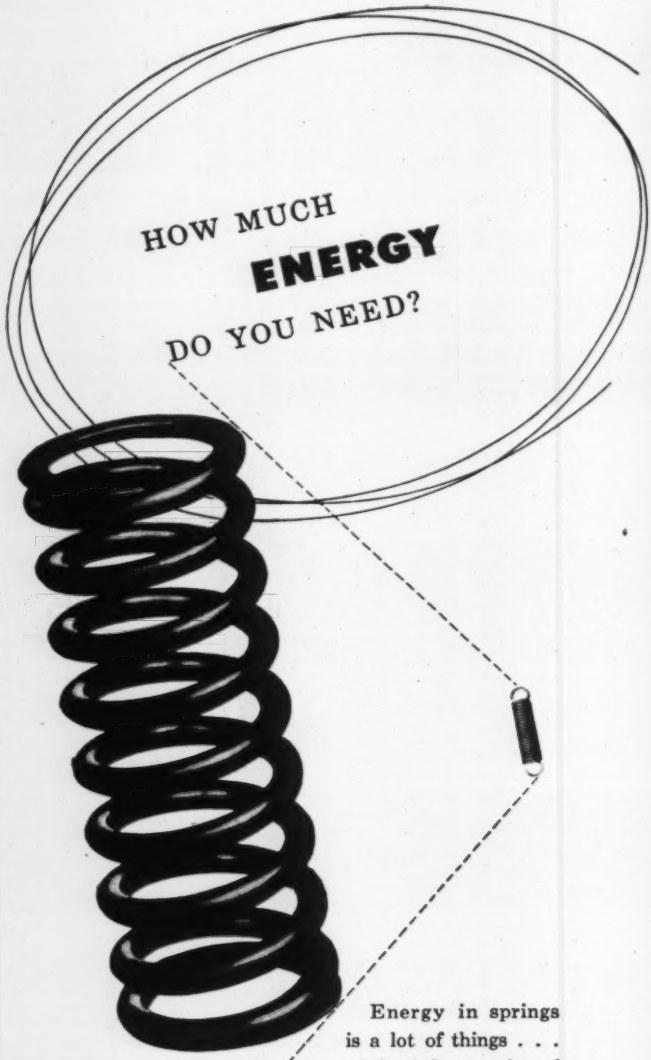

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which lists over 50 different Dow Corning silicones according to their physical form and applications. Important properties of each product and code numbers for obtaining more information about any particular product are conveniently presented in this 4-page bulletin.

270 COOLING TOWERS

Marley Co. Inc.—Bulletin DFA-52 introduces an entirely new design tower for capacities up to 1800 gpm. The Double-Flow Aquatower offers exceptional simplicity of construction and operation. Pumping head is very low since tower height is approximately one third that of other induced draft towers of similar capacities. Seven standard sizes are offered in either all-steel or wood-framed with asbestos cement board casing.

271 VIBRATING SCREENS

Link-Belt Co.—20-page book No. 2377 describes Model "UP" vibrating screens for fast accurate dry screening of light and fine materials, and model "NRM" liquid vibrating screens for low-cost, high-speed separation of solids from liquids. Descriptive material includes specific information on how to select the right screen and screen cloth for maximum operating efficiency.

272 VALVES, PIPE FITTINGS, ETC.

Kennedy Valve Mfg. Co.—Catalog covers full Kennedy line of iron and bronze valves; malleable iron, cast iron and bronze pipe fittings; fire hydrants and indicator posts. It gives detailed information on design, specifications, selection, and application. Special valves and accessories also treated in detail.

273 BALL BEARING SWIVEL JOINTS

Chiksan Co.—Catalog No. 51-C illustrates and describes complete line of over 500 different types, styles, and sizes, with data on working pressures, maximum temperatures, dimensions, and weights. 12-page catalog No. 2A gives data on aircraft hydraulic swivel joints for pressures from 1000 psi to 3000 psi.

274 ELEVATOR PLANTS

Charles W. Lerch & Assoc.—"Cost of Errors In Elevator Plants" is a new booklet for all building owners, managers, and administrators—especially those who operate office buildings, hospitals, lofts, apartments, and hotels.

275 SHAPED WIRE

Page Steel & Wire Div., American Chain & Cable Co., Inc.—16-page catalog DH-1226 describes how to cut production costs by the use of Page shaped wire available in low-carbon, high-carbon, and stainless steels, specially processed to meet exacting requirements for temper and physical properties, in a wide range of commercial finishes.

276 STEEL-BELT, WATER BED, COOLING CONVEYERS

Sandvik Steel, Inc., Conveyor Div.—A new 20-page booklet describes the patented Sandvik water-bed conveyer. It covers the development, design, and cooling applications for Sandvik's water-bed conveyer which employs a flat continuous band of steel operating over a trough of circulating water.

277 PROTECTED PNEUMATIC TUBING

Bailey Meter Co.—Bailey Armortube Cable, a flexible protected multitube transmission line, will (1) cut installation time and costs; (2) conserve space and critical materials; (3) protect instrument and control connecting lines; and (4) improve plant appearance. Bulletin No. BA-927, an illustrated 4-page, 2-color specification, discusses practical applications of 1/4-in-OD tubing in protected cable bundles of 4, 8, and 12 tubes.

278 FLEXIBLE SHAFTING

F. W. Stewart Mfg. Corp.—Bulletin "Flexible Shaft Assemblies," describes new power drive circle Ess flexible shafting. Greater opportunity for diversified streamlined power transmission is offered for use in all types of metal, plastics, porcelain, or woodwork. They can be applied in hundreds of finished operations. Three types of power drive flexible shafts are presented—for heavy, medium, and light duty in commercial or industrial work.

279 CONVEYER SYSTEMS

Allen-Sherman-Hoff Co.—Hydrovac catalog No. 448 describes the various methods developed for pneumatic materials handling and illustrates the special components involved. The automatic sequence head, which allows push-button control of the entire ash and dust-handling system, is also described in detail.

CATALOG GUIDE

280 HIGH-SPEED UNITS

Philadelphia Gear Works, Inc.—Bulletin 300 illustrates and describes Philadelphia high-speed units for application on turbine reduction drives to pumps and as speed increases to high-speed pumps or fans. Included are diagrams, dimensions, and horsepower ratings.

281 GRATING, FLOORING, STAIR TREADS

Blaw-Knox Co.—Bulletin 2365 features the Electroforging—® process of manufacturing Blaw-Knox grating and stair treads. Illustrations, charts, and descriptive data point up the strength and permanence of Electroforged, one-piece construction of grating that has proved the ideal flooring for practically every industry. Two pages of this 16-page bulletin include an accurate table of safe loads, sizes, and specifications for Blaw-Knox grating and stair treads.

282 SOLENOID VALVES

Waterman Engineering Co.—A new illustrated booklet describes with photos and diagrams several new and improved high-pressure solenoid valves—showing their construction and their typical application. They are especially suitable for all hydraulic systems handling noncorrosive fluids.

283 RECORDING MECHANICAL COUNTERS

Streeter-Amet Co.—New illustrated bulletin on latest recording mechanical counters actuated by electrical impulses. Many new uses for these recording counters are depicted for industry as well as for science. Machine shops, airports, hospitals, scientific laboratories are among the wide range of fields where they can be used with profit. Variable components multiply the recording possibilities for a variety of counting and timing jobs.

284 OSCILLATING CONVEYERS

Link-Belt Co.—16-page book No. 2244 contains layout drawings selection charts, dimensions, and weights for the "PA" positive action, roller-bearing eccentric-type oscillating feeder-conveyer. It is particularly recommended for handling sharp, abrasive, fine, lumpy, sticky, hot, or other difficult-to-handle materials.

285 HOT-WATER HEATERS, HEAT EXCHANGERS

Patterson-Kelley Co.—Catalog No. 202 contains 40 pages giving a rapid means of selecting the correct hot-water heater for forced circulation. The booklet includes condensate cooler tables, dishwater booster heater tables, gravity circulation tables, hot-water service heater tables, pressure-drop tables, and typical piping arrangements. Capacities covered range from 95 to 101,000 gph; steam pressures from 0 to 100 psig; and water temperatures from 40 to 100 F inlet and 80 to 300 F outlet.

286 ADJUSTABLE PIPE HANGERS

Power Piping Div. of Blaw-Knox Construction Co.—New 100-page catalog 51 features the Blaw-Knox Functional spring hangers, vibration eliminators, and overhead roller assemblies. The improving and simplification of complicated piping systems is clearly explained by simple charts and specific clear line dimensional drawings. A Technical Section of the catalog enables a piping engineer to solve most hanger load problems and thus determine the hanger requirements for the particular piping under consideration.

287 METERS

Builders-Providence, Inc.—Latest catalog describes the improved Model SMKS Shuntflo meter for steam, air, or gas. In addition to the new streamlined appearance of this time-proved meter, several changes have been made in the mechanism for greater strength and easier replacement of parts.

288 BULK MATERIALS BIN LEVEL INDICATOR

Bin-Dicator Co.—20-page bulletin fully describes and illustrates bin level indicator which gives automatic control of machinery in response to fluctuating level of materials in silos, bins, hoppers, etc. Dimensional drawings, mounting details, typical applications, wiring diagrams, and revealing list of present users. Illustrated applications to stoker operation, flour packing, chemical proportioning, concrete mixing plant, packaging ores, salt, feed, chemicals, candy, etc.

289 FEEDERS

Omega Machine Co.—New bulletin describes in detail the Model 50-8 Chemizer, a belt-type feeder designed to meet the growing need for a small weighing feeder of high capacity, suitable for handling all dry materials, accurately, continuously, de-

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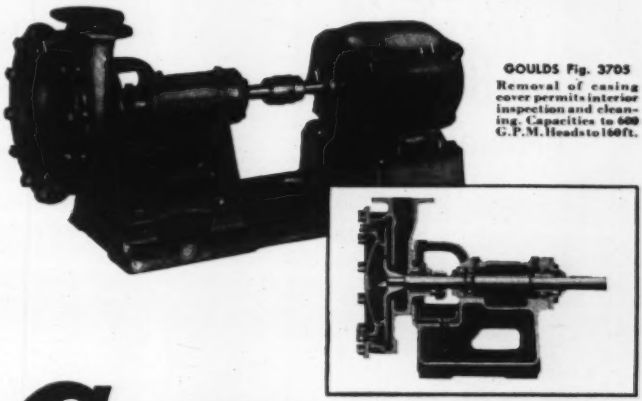


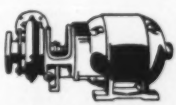
GOULDS Fig. 3705
Removal of casing cover permits interior inspection and cleaning. Capacities to 600 G.P.M. Heads to 160 ft.

Goulds STAINLESS STEEL CENTRIFUGAL PUMPS

Other GOULDS for General Industrial Use

GOULDS Fig. 3169
Single stage centrifugals for general processing purposes. Capacities to 1100 G.P.M. Heads to 180 ft.

GOULDS Fig. 3047
Vertical sump pump with nonclogging impeller for water containing large solids or fibrous materials.



GOULDS Fig. 3650
"Close-Cupld" single stage centrifugals for general industrial use. Capacities to 2000 G.P.M. Heads to 400 ft.

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290 HIGH VACUUM PUMPS

Kinney Mfg. Co.—Bulletin V-51B describes Kinney single-stage vacuum pumps and compound vacuum pumps for low absolute pressures to 10 and 0.2 microns respectively, with displacements up to 1600 cfm. The mechanism of these pumps is pictured and capacity tables are included.

291 ELECTRIC-POWER DRIVES

Sterling Electric Motors, Inc.—Bulletin shows over 70 illustrations of variable-speed and geared low-speed electric-power drives that have increased production, improved product quality, reduced production costs, modernized equipment, improved plant layout, increased plant safety and, improved new machine design.

292 BLUEPRINT MARKING PENCIL TEST KIT

American Lead Pencil Co.—Kit contains samples of new Venus unique colored pencils for marking on blue or white prints. 54 per cent stronger—sharpens to a sharp needle point and holds it. 27 per cent greater markability—brilliant clear marking—waterproof.

293 FLEXIBLE COUPLINGS

Ajax Flexible Coupling Co.—Bulletins available on the new Ajax Dihedral Coupling designed to handle misalignment. Misalignment capacity and performance of the new Ajax Dihedral Couplings are based on a tooth shape which provides for maximum misalignment with clearance or backlash held to oil film requirements.

294 FANS AND BLOWERS

Chelsea Fan & Blower Co.—Complete catalog, price sheet, and engineering bulletin describes 30 fan types in over 300 sizes. Included are complete specifications, dimensions, installation diagrams, and product photographs, as well as extensive information on the proper selection and installation of fans for every industrial, commercial, and residential requirement.

295 POWDERED METALS

United States Graphite Co.—263-page catalog shows typical parts such as bearings, bushings, thrust washers made of Gramix, a product of powder metallurgy, and their applications in many uses. Also gives qualification tests, factors of design, decimal equivalents, press fit values, running clearances, many progressive size listing tables, dimensional limits and tolerances, methods of assembling, and list of local sales representatives.

296 STEAM TRAP BOOK

Armstrong Machine Works—Catalog J, a completely new 44-page combination catalog and steam-trap manual, gives details of trap operation, construction, selection, installation, and maintenance. Contains charts, tables, and safety-factor data for trap selection.

297 ELECTRIC PAN-L-HEAT OVENS

Advance Heating Div., Jensen Specialties, Inc.—16-page bulletin, illustrated, on electric heating ovens, driers, and booster heaters for finishes, varnishes, coatings, textiles, paper, glazes, adhesives, cements, foundry molds and cores, preheating castings, expanding metal parts, and many other applications. Describes electrical construction, mechanical and thermal features and capacities. Also informational form to secure specific recommendations.

298 PACKAGE-TYPE COMPRESSOR

Ingersoll-Rand Co.—A 4-page folder describes the XLF package-type L-design two-stage 100-psi air compressor, with built-in synchronous motor sizes 125 to 350 hp for continuous full load service. Features pipeless, Thru-Frame Air Flow from intake to discharge connections which are on the frame, packaged tube-and finned intercooler within the same frame, and full floating aluminum bearings. Easily installed as a unit and requires minimum of adjustment and maintenance.

299 LUBRICATING SYSTEM

Trabon Engineering Corp.—Bulletin No. E463 describes operating principles and engineering data on type "M and MX" oil and grease systems for all types of machinery. Fully hydraulic positive-piston-type valves measure lubricant in volumes from 0.010 to 0.15 cu in., use no springs or ball check valves. May be installed on new or machinery already in operation.

300 SLUG BUSTER SNUBBER

Burgess-Manning Co.—Bulletin describes the features and applications of the new SDG Slug Buster Snubber designed for use in the petroleum, chemical, and industrial fields. The SDG Snubber is designed to reduce noise from engine exhausts and vacuum pump discharges to the noise level of the surrounding industrial area.

301 METALLURGY

Molybdenum Corp. of America—Timely information on alloying materials is given in separate pieces devoted to molybdenum wrought steels, molybdenum cast steels, molybdenum cast irons, and to tungsten in steel manufacture. Compositions, procedures, and data on results are given. A general catalog includes the metallurgical uses of boron.

302 HY-VO CHAIN DRIVE

Morse Chain Co.—Complete catalog describes the Hy-Vo chain drive. The catalog includes (1) a basic discussion of operating principles of chain drives, (2) highlights of Hy-Vo's new design principles, (3) description of Hy-Vo's capacities in high-speed heavy-duty field, (4) speed ranges and service factors, (5) installation, lubrication, and maintenance data.

303 INDUCED AND FORCED-DRAFT FANS

Green Fuel Economizer Co.—Bulletin No. 168, 20 pages, describes the Green line of induced and forced-draft fans; including stack-supporting fans. Many variations noted.

304 THRUSTORQ FORCE-MEASURING DEVICE

Hagan Corp.—The Hagan "ThrusTorq," air-operated force-measuring device is pictured and described in bulletin No. 9345. The ThrusTorq is employed in engine-testing laboratories, engine and aircraft factories, automotive and petroleum industry laboratories and plants, and in chemical and other plants for continuous and intermittent weighing applications.

305 CLUTCHES AND POWER TAKE-OFFS

Rockford Clutch Div., Borg-Warner Corp.—Bulletin on power transmission control shows typical installation of Rockford clutches and power take-offs. Contains diagrams of unique applications. Furnishes capacity tables, dimensions, and complete specifications. Every production engineer will find help in this handy bulletin when planning his new products.

306 PACKAGED BOILERS

Orr & Sembower—Bulletin No. 1218 describes the Powermaster packaged automatic boiler—construction details, operation, controls, standard and optional equipment, types of fuel, dimensions, horsepower ratings, steam output, fuel consumption and similar data for the complete range of models from 15 to 500 hp.

307 LUBRICATION

Universal Lubricating Systems, Inc.—Universal hydraulic grease fittings, couplers, swivel couplers, control handle for boosting grease pressures to 12,000 lb, and top oiler for upper cylinder lubrication are illustrated and described in a 14-page 1951 Industrial Catalog.

308 PROPORTIONING OIL BURNER

Anthony Co.—Bulletin 501 illustrates and describes in detail the Anthony Nebulyte proportioning oil burner. The air and oil flows are interlocked and metered by one operating lever for either manual or fully automatic operation. Bulletin contains applications, capacities, and other details. Included is a condensed catalog of other types of Anthony equipment.

309 PIPING FABRICATION AND ERECTION

Dravo Corp.—A 24-page illustrated booklet, bulletin No. 1700, shows piping installations in steel mills, for gas transmission systems, central power stations, water pumping stations, heating plants, oil refineries, and chemical process plants. Dravo's engineering and fabrication facilities are also illustrated and described.

310 VALVES

Golden Anderson Valve Specialty Co.—A new 8-page bulletin G-3 describes the features of cushioned automatic water and steam valves. Featured are float valves, altitude valves, check valves, solenoid-operated valves, reducing valves, relief valves, and non-return valves.

BUYER'S CATALOG GUIDE

311 ROLLED AND WELDED STEEL PRODUCTS

Cleveland Welding Co.—Bulletin No. W-500 describes Cleve-Weld circular, rolled, and welded steel products. Various types of circular weldments and accompanying advisory service are illustrated.

312 ALUMINUM MILL

Farrel-Birmingham Co., Inc.—Equipment News, No. 35-M-512, describes and illustrates 9 and 21-in. × 46-in. four-high aluminum mill. High-speed mill, installed in foil plant, handles primary reductions down to 0.001 in. Mill has adjustable voltage control system, electrolimit foil gage, large vernier dials. Bulletin also describes other rolling mill equipment.

313 EFFECTS OF CHECK VALVES IN OVERCOMING WATER HAMMER

Williams Gauge Co.—The cause, effect, and control of water hammer in piping systems are considered in a new 8-page bulletin. After describing water hammer in nontechnical terms, the brochure indicates its potential damage to piping, instruments, and other parts of water systems, and then considers methods of controlling it.

314 TUBE CLEANERS AND TUBE EXPANDERS

Thomas C. Wilson, Inc.—A 48-page catalog No. 76-A covers mechanical tube cleaners. This catalog depicts many types and sizes of cleaners driven by air, water, steam, or electric. A comprehensive tube expander and accessory catalog is also available for expanders 1/4-in. OD and up.

315 MARKING TOOLS

M. E. Cunningham Co.—Bulletin J-547 describes the Cunningham line of "Safety" marking tools. It illustrates the standard line of marking devices and includes symbol charts and special codes.

316 SMALL PURIFIERS

V. D. Anderson Co.—New 6-page bulletin, No. 500, describes the small line type Hi-eF Purifier. Folder lists many functions of this new unit which is used to clean up small pipe lines carrying live or exhaust steam, vapors, and air.

317 HIGH-SPEED STEEL

Firth Sterling Steel & Carbide Corp.—Catalog 10-070 describes Van Chip M-3, a new molybdenum-tungsten high-speed steel that is especially useful where abrasion resistance and ability to hold close tolerances is important. Gives complete data, such as, typical analysis, characteristics, heat-treating, applications, etc.

318 CONDENSIFILTER

Hankison Corp.—Hankison model B-30 Condensifilter, which removes water and oil from compressed air used to operate instruments, is described in a new two-page bulletin. Measuring only 15 in. high × 9 in. in diam, this compact unit removes water by condensing the air through passing it over a series of cooling copper coils, then removes oil, sludge, and other foreign material by passing the compressed air through a filter cartridge consisting of five hexagonal chambers in parallel. Self-purging trap automatically discharges the condensate.

319 WATER PROBLEMS

Hall Laboratories, Inc.—Industrial water problems of all kinds—procurement, treatment, usage, and disposal—and the facilities and services offered in coping with them are described and charted in a new booklet. It points up the importance of water in all kinds of industries and industrial operations.

320 DUST CONTROL

W. W. Sly Mfg. Co.—A revised 20-page treatise, bulletin No. 98, on industrial dust collection dis-

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CATALOG GUIDE

cusses the principles of dust control by filtration, determination of air volume, hood design, piping, and other features, and contains numerous diagrams, tables, and other valuable information.

321 RECORDING OSCILLOGRAPH

Consolidated Engineering Corp.—Bulletin 1500B pictures and describes Type 5-114 Oscillograph for the recording of static or dynamic data. Instrument handles up to 18 traces simultaneously at 1/2 to 115 ips speeds. Valuable in aircraft, railroad, automobile, and other industries requiring accurate test data.

322 BOILER-WATER COLUMNS

Reliance Gauge Column Co.—New bulletin No. 516 describes boiler-water columns and gage equipment such as the original "alarm" water columns, remote reading water-level gage, liquid-level alarms, illumination equipment, gage valves, gage cocks, etc.

323 ROLLER CHAIN, SPROCKETS

Morse Chain Co.—Catalog C55-50 gives details on prices, available sizes of over 400 sprockets, and information on stock roller chain from 3/4 to 2-in. pitch. Also included are data on dimensions, drive selection, service factors, installation, and maintenance.

324 PIPE AND TUBES

National Tube Co., Tubing Specialties Div.—Bulletin 26 presents technical data on 25 alloy steels suitable for high-pressure high-temperature service. Includes many tubular products manufactured in accordance with ASME Boiler Code specifications. Relative cost figures aid in selecting best alloy for special service.

325 VALVES AND REGULATORS

Watts Regulator Co.—Catalog No. 52 contains typical and popular plumbing and heating safety valves and controls manufactured. Included are temperature and pressure relief valves, vacuum relief, and hot-water tempering valves for domestic hot-water supply systems.

326 DUST AND FUME COLLECTORS

Northern Blower Co.—Catalog 1002-6 describes exhaust fans for dust collecting and air handling and includes complete performance tables, test curves, etc. Plans and elevations of typical dust-collecting installations are shown. Separate additional bulletins contain descriptions, dimensions, capacities, etc. of Norblo bag type, hydraulic type, and centrifugal dust collectors.

327 INDUCTION HEATING

Ohio Crankshaft Co., Tocco Div.—New catalog 22, 20 pages, describes the principles, applications, and equipment of Tocco induction heating. Typical results of induction hardening and heat-treating, and results of induction heating for forming and forging are given.

328 RUST PREVENTATIVES

Rust-Oleum Corp.—Catalog 251, a 16-page, two-color, general catalog lists Rust-Oleum rust preventive applications. Of particular importance to those requesting literature is the fact that this RUST-OLEUM features the use of color chips throughout to illustrate exact color. Detailed information and technical data complete with applications, resistance qualities, drying time, thinners and special applications are included with each.

329 COAL-HANDLING EQUIPMENT

Bartlett-Snow—Bulletin No. 103 describes central station coal-handling equipment including a complete design, engineering, fabricating, and erection surface. Many illustrations of Bartlett-Snow equipment in operation are provided.

330 FLOW SIGNAL TRANSMITTER

Hagan Corp.—The Hagan flow signal transmitter is described in a new bulletin, No. 2551. This pneumatically operated pressure-differential measuring unit transmits proportional signals to remote recording or indicating instruments, or to automatic control elements. The signals may be linear with flow or linear with pressure differential. Diagrams in the bulletin illustrate seven suggested uses of the transmitter in measurement of flow, liquid fuel, liquid level, and absolute pressure. Flow applications include measurement of steam output from a boiler, superheater or evaporator; of feedwater flow to a boiler; of liquid flow through pump units; and of gas, vapor, or liquid flow in process systems.

331 TUBE FITTINGS

Parker Appliance Co.—Catalog No. 203 describes Parker industrial tube fitting in all current types, sizes, shapes, and material. This catalog also in-

cludes a section on tube fabricating equipment, information on flaring tools, tube cutters, hand tube benders, and bench-mounted tube benders.

332 PNEUMATIC INDUSTRIAL CYLINDERS

Westinghouse Air Brake Co.—A new streamlined class of pneumatic industrial cylinders—both with noncushioned and cushioned adjustable stroke—are described in leaflet No. 9458-I. Solid barrel construction with rotating heads provides compactness and ease of installation. They are available in diameters from 1½ in. up with stroke and mounting to suit any requirement.

333 PRESSURE REGULATORS

Chaplin-Fulton Manufacturing Co.—Bulletin 46 describes Model 46 pressure regulator. Two new features are used in this design: The O-Ring to replace the stuffing box, and the "Dynaknob" to improve the degree of accuracy in outlet pressure control.

334 ENGINEERED FILTRATION

Cuno Engineering Corp.—New, 6-page bulletin No. 1148-PJL, gives complete data on Cuno Auto-Klean filters—edge filtration plus positive mechanical cleaning; Cuno Flo-Klean filters—backwash filter cleaning with no loss of fluid; Cuno Micro-Klean filters—replaceable element micronic filters. Description of models and capacities for industrial filtration installations.

335 WATER VAPOR PHYSICS

Pittsburgh Lectrodryer Corp.—Bulletin No. 218, "The Moisture in Our Atmosphere," a 12-page bulletin, discusses the fundamental physics of water vapor. The nature and behavior of water vapor are treated in a logical down-to-earth manner with psychrometric chart explanations. The use of solid adsorption equipment for dehumidification is also described.

336 DIRECT, POSITIVE COPIES

Charles Bruning Co.—A new, illustrated brochure—"The Copyflex Process"—describes in detail this modern, low-cost method of copying as used by business and industry everywhere. Booklet includes information on the operation of Bruning Copyflex (Whiteprint) equipment and the various uses of the unsurpassed range of Copyflex sensitized materials.

337 SPACE HEATERS

Dravo Corp.—Bulletin No. 526 describes Dravo "Counterflo" direct-fired space heaters in a range of gas- or oil-fired models with outputs from 400,000 to 2,000,000 Btu per hr. A comparison chart shows that steel requirements for these heating systems can be reduced 50 to 70 per cent through the use of direct-fired warm air heaters.

338 WATER GAGES

Ernst Water Column & Gage Co.—New bulletin 10-1-51-R illustrates all types of high-pressure gage glasses for boilers, tanks, heaters, etc. Also includes safety glass protectors, illuminators, try cocks, and compressed carubestos valve disks.

339 HYDRAULIC LUBRICANT PUMP

Trabon Engineering Corp.—Bulletin No. 514 gives complete data on the "Hydra-Lube" pump and reservoir assemblies for oil or grease systems. Readily adaptable to machine tools, mining machines, presses, and other equipment using hydraulic power. Adjustable volume discharge gives fully automatic lubricating system without electric or mechanical connections.

340 FLOWMETERS

Hagan Corp.—Ring balance mechanical flowmeters are described and illustrated in detail with photographs, diagrams, and data on dimensions and capacities in bulletin 2M50. Covered is the ring balance principle of operation, which is said to be unique in that it maintains high accuracy at low flows. Among other reported features are ease of adjustment, recalibration by deadweight method or by a water column, high accuracy and elimination of over-range-operation troubles, for both low-pressure and high-pressure flowmeters of this line.

341 PIPE LINE STRAINER

J. A. Zurn Mfg. Co.—Engineering Data Manual No. 951 contains complete descriptive and illustrative details of pipe-line strainers for all purposes. Duplex strainers in plug, disk, and gate types; Sinlex, V-type, and special strainers in size range from ¾ to 24 in. inclusive.

342 GAS AND AIR LINE SNUBBERS

Burgess-Manning Corp.—Bulletin describes features and applications of Gas and Air Line Snub-

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Capacities to 150 G.P.M.

Heads to 500 Ft.

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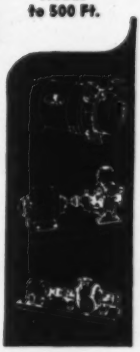
Apco—the pump with but one moving part, the impeller — is famous for long-lived, efficient performance on small capacity, high head duties. Available in Single Stage, Two Stage and 4-Stage Tandem for high pressures — and Water Jacketed for high temperature and highly volatile liquids.

Write for Bulletins 111, 111-A, 111-WJ



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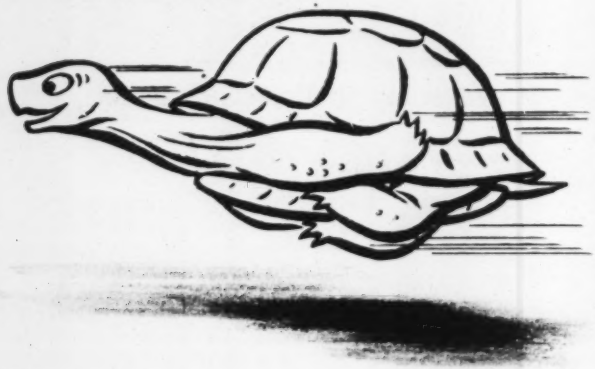

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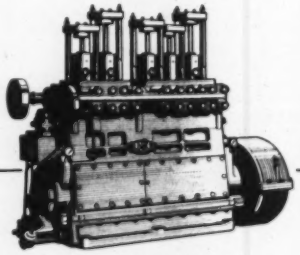

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CATALOG BOOKS

bers, specifically designed to reduce pipe-line surging and the damaging vibration which it produces, and to eliminate troublesome metering due to the pulsating flow of compressible fluids from compressors, pumps, or blowers. These Snubbers may be used for suction or discharge services. They find wide application in oil and gas production, oil and gas well repressuring, gas transmission, petroleum refining, and the petrochemical process industry.

343 PACKAGED BOILERS

Erie City Iron Works—Bulletin SB-38ME describes the Keystone 2-drum water-tube packaged-type steam generator. Shop assembled to include steel-cased boiler on steel base—boiler trim, induced-draft equipment, combustion control—safety controls, burner for oil or gas or for both interchangeably. Capacities: 2490 lb of steam per hr to more than 26,550. Pressures: 160 psi. up.

344 RADIAL AND UNIVERSAL DRIVESHAFTS

Morse Chain Co.—Bulletin F41-51 gives complete data and specifications on the Morse Morflex radial driveshafts with spline-jointed tubular shafts and Universal driveshafts with one-piece and spline-jointed tubular shafts. It lists dimensions, working table of maximum recommended lengths, and rotative speed.

345 BOILERS AND STOKERS

James Leffel & Co.—28-page Bulletin No. 236, describes 6-hp to 250-hp (these are normal and conservative ratings and are subject to considerable overload capacities) Leffel Scotch-type boilers and underfeed stokers. Photos and cutaway drawings show design and application details. Test results, case studies, and specification data are included. The Leffel automatic underfeed stoker which is also suitable for other makes of Scotch-type boilers is described.

346 OIL-HARDENING STEEL

Firth Sterling Steel & Carbide Corp.—Catalog 20-080 describes Chimo, a tough, oil-hardening steel originally developed for tools that resist shock, vibratory stresses, and at the same time hold a good cutting edge. Provides complete information about typical analysis, characteristics, heat-treating, etc.

347 DIE-LESS DUPLICATING

O'Neil-Irwin Mfg. Co.—Hydraulic Power Bender, Variable Speed Powershear, and Air Powered Rod Parter have all been added to the "Di-Acro" Line to increase the production possibilities of the "Di-Acro" System of Die-Less Duplicating. 40-page "Di-Acro" Catalog contains complete information covering these power machines as well as all manually operated "Di-Acro" benders, brakes, shears, rod parters, notchers, and punches, which are offered in a variety of sizes.

348 DUST COLLECTORS

Green Fuel Economizer Co.—16-page Bulletin describes "Aerodyne" dust collector which operates on the aerodynamic principle of separation. Suitable for steam and power plants, cement, and other process plants, foundries, etc.

349 OIL AND GAS BURNERS, STOKERS

Iron Fireman Mfg. Co.—New 16-page, 3-color general catalog No. 2129 presents the complete line of Iron Fireman automatic firing equipment, including industrial and commercial oil and gas burners, combination oil-gas burners, pneumatic spreader and underfeed stokers for power and heating applications. Includes descriptions, illustrations, engineering data, and Selector Guide-Capacity Tables covering all equipment.

350 WELDING

American Welding & Mfg. Co.—Bulletin CA-50 discusses fabrication by controlled technique flash-butt welding. Illustrated are a variety of welded rings and bands and weldments. The bulletin discusses research engineering, fabrication technique, scientific inspection, and precision machining with many successful welding problems.

351 MULTIPLE NUT RUNNERS

Ingersoll-Rand Co.—An illustrated folder features the applications and advantages of multiple nut running. It points out how two or more nuts can be driven simultaneously, to the same degree of tightness with no torque reaction to the operator.

352 STEEL FLOORING AND ARMORING

Dravo Corp.—Machinery Div.—Catalog No. 1103 describes various types of open-steel flooring and armoring and discusses different types of Tri-Lok open-steel flooring and safety treads. Specification data, safe-load tables, installation methods, and other pertinent information, are included.

CATALOG GUIDE

353 WORM GEAR SPEED REDUCERS

D. O. James Gear Mfg. Co.—Current 8-page illustrated catalog No. 45-C containing valuable informative engineering data and prices on single and double worm gear reducers. Type "S" or single reduction comes in 24 sizes, in ratio ranges of 5.66-1 to 100:1 and from 0.04 to 15 hp. Double worm gear reducers are available in 10 sizes with ratio ranges of 87:1 to 10,000:1 and from 106 in-lb to 3480 in-lb output torque. Stock sizes, available for immediate shipment, are plainly indicated.

354 DUST CONTROL

American Air Filter Co., Inc.—A 22-page illustrated manual of exhaust hood design shows how effective exhaust hoods have been designed for many operations common to the metalworking industries.

355 LUBRICATION CHART

Hyster Co.—A 26-point lubrication chart, Form 1102, covers eight Hyster industrial truck models. Folding into a pocket-size handy reference, the chart numbers all serving points of the eight models, tells when they should be serviced, and recommends certain types of oils and greases.

356 BALL BEARINGS AND PILLOW BLOCKS

Ahlberg Bearing Co.—A 24-page catalog, No. 441, lists available ball bearings and pillow blocks. Includes AFBMA bearing identification code, adapter sleeves, decimal equivalent chart, lock nuts and washers, lubrication, and unground bearings.

357 DRAFT GAGES

Ellison Draft Gage Co.—Bulletin No. 109 describes inclined and vertical tube draft gages for field and laboratory work, for heating, ventilating, and air conditioning engineers. Constant zero. Level and tube replaceable in field. Also saturator gages for coke plants, steel mills.

358 AIR PREHEATERS

Air Preheater Corp.—First section of Catalog on Ljungstrom Air Preheaters presents an over-all picture of the Ljungstrom, its functions, and operation. Examples of installations of the Ljungstrom continuous counterflow regenerative-type preheater, covering a range of diverse applications, are shown in diagrammatic form, together with photographs of the Ljungstrom in sufficient detail to make its principle and operation clear.

359 TORQUE CONTROL

P. A. Sturtevant Co.—27-page illustrated manual designed to aid those persons responsible for torque control specifications and applications. It depicts the general principles of torque tools and methods of use.

360 ECONOMIZERS

Green Fuel Economizer Co.—Bulletin No. 169, 8 pages, describes Green premier "Diamond" economizers with cast-iron (type 25) and steel (type 12) tubes.

361 PUMPS

Aurora Pump Co.—Condensed Catalog M, embodying illustrations, suggested uses, specifications, and condensed selection tables for Aurora centrifugal and Apco turbine-type pumps and water systems.

362 TECHNICAL BOOKS

The American Society of Mechanical Engineers—1952 Catalog of ASME Publications. A 20-page descriptive price list of current books, standards codes, research reports, and periodicals published by the Society.

363 FRACTIONAL HORSEPOWER VARI-SPEED MOTODRIVE

Reeves Pulley Co.—A 12-page bulletin, M-513, describes the Reeves fractional HP Vari-Speed Motodrive. It shows standard assemblies, dimensional diagrams and complete rating tables of this unit which has a speed range of 10:1 in 1/4 to 3/4-hp sizes. The unit can be equipped with manual control, extended control, electric remote, or mechanical automatic control.

364 OIL SEALS

National Motor Bearing Co.—Catalog No. 102A lists standard types and sizes of National oil seals. Listings are presented two ways: (1) By shaft diameter and (2) by seal or design number. Listings indicate proper housing bore and thickness of the oil seals. This catalog is divided into three sections: (1) engineering data, (2) listings of leather series, and (3) list of Syntech series (synthetic rubber).

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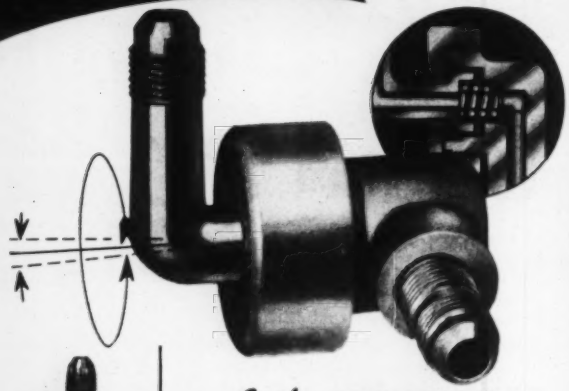

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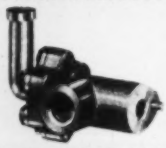

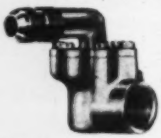

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CATALOG NOTICES

365 STEAM GENERATORS

Ames Iron Works—New Bulletin No. 1050 covers complete details of the AMESTEAM Generator and indicates standard sizes, pressures, and fuels.

366 CONTROL INSTRUMENTS

Leeds & Northrup Co.—Speedomax electronic instruments for automatically measuring or controlling temperature, speed, force, CO_2, SO_2, O_2, H_2, electrolytic conductivity, pH, electrical load, and daylight illumination are described and listed in new catalog ND46(1). The catalog also lists several specialized recorders. Numerous illustrations show production and research applications.

367 METAL FABRICATION

L. O. Koven & Brother, Inc. Bulletin No. 490, 24-pages, illustrates by photographs and sketches the complete story of Koven's experience, knowledge, and facilities in the field of metal fabrication. Koven's two large plants are fully equipped for the fabrication of metals in all gages from 18-gage to the heaviest plate.

368 BOILERS

Kewanee Boiler Corp.—Kewanee Steel Boilers Lo and Hi Pressures Series. Welded and Riveted for mechanical or hand-firing and convertible. Steam radiation ratings 1380 to 42,500 sq ft commercial, 330 to 3000 sq ft residential sizes. Shown in 24-page General Catalog 80.

369 RECORDING OSCILLOGRAPHS

Hathaway Instrument Co.—A 30-page booklet, SP-220, describes 8 types of multielement oscillographs for recording quantities which may undergo rapid variation. The number of elements varies from 6 to 48, and the maximum frequency response from 5000 to 200,000 cps. This equipment is useful for recording both transient and periodic phenomena, electrical and mechanical.

370 MAGNETIC SEPARATORS

Jeffrey Mfg. Co.—An 8-page bulletin, No. 846, gives details of Magnetic Separators for wet concentration and magnetic recovery problems. Typical operating results are given on Eastern Magnetite as well as on the recovery of magnetic media. Profusely illustrated and principles of operation are well covered.

371 STEAM GENERATORS

Preferred Utilities Mfg. Corp.—Bulletin 1000 contains a description of the principal design features of the four-pass Preferred unit steam generator. A complete list of standard and accessory equipment plus a table of dimensions is also included.

372 VALVES

Ohio Injector Co.—A new catalog 51-FS shows a complete line of 600-lb forged steel, gates, globes, angles, checks, and screwed flanged socket-weld type in standard and special trim.

373 EXPANSION JOINTS

Badger Mfg. Co.—Catalog features directen-flexing self-equalizing and nonequalizing expansion joints: D-F S-E joints, in various metals and alloys, for wide ranges of pressures and temperatures. Nonequalizing for low pressures—thermal expansion table, installation diagrams, and data on flanged ends, welded ends, traverse, axial movement, etc. Designed to meet custom requirements.

374 HERMETICALLY SEALED RELAYS

Guardian Electric Mfg. Co.—Hermetically Sealed Relay Catalog 5-H contains ten pages of photographs and specifications, application, operating, and contact data; diagrams and other information on various types and designs of hermetically sealed relays.

375 VARIABLE SPEED DRIVES

Reeves Pulley Co.—A new 12-page bulletin, G-509, describing the basic operating principals of the Reeves variable speed drives contains rating tables and dimension drawings and illustrates variable speed drives ranging from ¼ to 87 hp with stepless speed changes within ratios from 2.1 to 16.1.

376 PULVERIZERS AND CRUSHERS

Jeffrey Mfg. Co.—Materials being successfully reduced by Jeffrey swing hammer pulverizers and crushers, cross-section views of various sizes, capacity tables, and many photos of these and other types of reduction units are given in a 36-page catalog No. 837.

377 PRESSURE AND TEMPERATURE REGULATORS

Spence Engineering Co., Inc.—A new 32-page booklet contains useful information about pilot-operated pressure and temperature regulators. Illustrated with photos, charts, and tables, it discusses main valves, controls, and strainers, gives capacity and flow data as well as dimensions and weights.

378 VALVES

Leslie Co.—Bulletin 513 describes the new "Class DV" Double-Seated Diaphragm Regulating Valves. Outlined in the bulletin, which is well illustrated, are the special features of these valves.

379 AXONOMETRIC DRAWING

John R. Cassell Co.—Axonometric Drawing in the mechanical field and the Palmer Time-Saver Modular Design Scales for the Architectural profession are emphasized and a number of other popular stencils are included in a new 20-page brochure.

380 OVERLOAD CUT-OUT

John Waldron Corp.—Catalog 51 covers description, engineering data, and operating features of cut-out couplings and cut-out pulleys. These are automatic devices which shut off motor and reset themselves to prevent loss from "down-time" due to overloads on conveyer drives.

381 VAPOR CONDENSERS

Doyle & Roth Mfg. Co., Inc.—New six-page bulletin describes a line of standard units designed with the chemical and process industry in mind. Through standardization and by stocking component parts, these units are readily available at low cost with delivery in type 304 and 316 stainless steel.

382 PROTECTIVE COATINGS

Pittsburgh Coke & Chemical Co.—A new booklet on Pitt Chem Cold Applied Tar Base Coatings describes the properties of the four types of coatings manufactured by the company and gives application directions. A full-page chart lists a comprehensive selection of typical structures and corrosive agents and recommends the coatings best-suited for each application.

383 AIR VALVE LINE

Hannifin Corp.—New 8-page broadside, bulletin 231 describes Hannifin's P-M (Pilot-Master) valve line, including 2-way, 3-way, and 4-way Master Valves and Pilot-Master Valves, the latter solenoid-controlled through integral pilot heads. Also covers a complete line of pilot valves for the remote control of master valves. Sizes: $^1/_4$ to $1^1/_4$ in. For air pressures to 150 psi—more when water or oil is the fluid.

384 MINIATURE BALL BEARINGS

Miniature Precision Bearings, Inc.—New 12-page catalog, illustrated with comprehensive specifications on more than 70 types and sizes of standard miniature ball bearings from $1^1/_2$ mm to $^3/_8$ in. OD. Includes material of particular interest to designers of precision mechanisms—applications, lubrication, design variations, special bearings, etc.

385 BLOW-THRU MULTITHERM UNITS

Clarage Fan Co.—Bulletin No. 1310. Air-conditioning units equipped with Zone Control maintaining different temperatures and different humidities in various parts of a building. Each zone individually controlled. Zone Control compensates for differences in solar radiation, exposure, wind velocity, and varying internal loads.

386 FANS AND BLOWERS

Hartzell Propeller Fan Co.—Revised general catalog No. 21A describes, illustrates, and gives specifications for the general line of Hartzell fans and blowers.

387 CHAIN DRIVES, CONVEYERS, ROLLER CHAINS, TENSION LINKAGES

Chain Belt Co., Baldwin-Duckworth Div.—Bulletins 51-7 cover installation, operation, and maintenance of chain drives and conveyers; No. 51-2 on double pitch roller chains; and No. 51-10 on tension linkages.

388 EXPANSION JOINTS

American District Steam Co., Inc.—The new ADSCO Corruflex Bulletin contains complete information on packless expansion joints. Many pages are devoted to simplified selection and installation data and to the design and construction of the packless joint. The bulletin includes discussions of thrust, forces, traverses, anchors, alignments, and related topics.

389 POWER TRANSMISSION MACHINERY

Dodge Mfg. Corp.—D-49 Junior, 256 pages, covers entire line of Dodge power transmission machinery. In addition to illustrations and descriptions of all major items, this book gives size ranges, dimensions, weights, list prices, and essential application data. Major Sections are devoted to Bearings, Take-Ups and Hangers; V-Belt Drives; Steel Pulleys; Speed Reducers; Friction Clutches, Couplings, and Collars; Vises; and Engineering Data.

390 ALUMINUM FORGINGS

Aluminum Co. of America—A 171-page book, "Designing for Alcoa Forgings," outlines forging processes and shows how they affect various problems and principles of design. Recommended forging design proportions are given in tables and illustrated by specific examples.

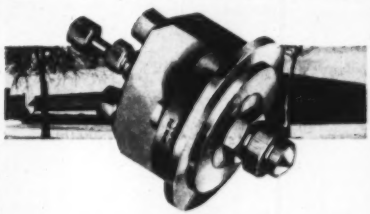
391 HEAT-TREATING FURNACES

Westinghouse Electric Corp.—A complete line of heat-treating furnaces—gas-fired or electric—and protective atmosphere generators are described in forty-page book No. B-5459 with useful calculating tables, definitions, and temperature conversion table.

392 VANE-TYPE HYDRAULIC PUMP

Denison Engineering Co.—New series of vane-type pumps, built for continuous duty at 2000 psi and convertible to fluid motor applications without alterations of any kind, are shown in bulletin P-5. The series includes models and sizes offering pump deliveries up to 70 gpm, and motor torque capacities up to 257 in-lb per 100 psi.

to the 99 plants in 100 who use SPRAY NOZZLES



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- Catalog No. 23 Pneumatic Atomizing Nozzles

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BLAW-KNOX Electroforged STEEL GRATING

393 BRONZE CASTING ALLOYS

American Manganese Bronze Co.—50-page edition of the "Reference Book on Bronze Casting Alloys" gives general information on composition, characteristics, and applications of many of the common or typical alloys. The book will help the engineer or designer in the selection of the right alloys for any general application.

394 GAS HOLDERS

General American Transportation Corp.—Bulletin No. WG-22 entitled "Wiggins Gasholder" describes a gas holder which is absolutely dry requiring no water, tar, or grease to seal the gas. The synthetic rubber seal eliminates costly maintenance and operating expenses of other gasholder types. Designed to handle industrial and chemical process gases.

395 CENTRAFIRE STOKER

Westinghouse Electric Corp.—Booklet No. B-3890-A. The Westinghouse link grate combined with the centrafire principal gives controlled distribution of air and coal over entire combustion area. This unit will fire any grade coal, create optimum burning, and discharge ash without interrupting coal feed or reducing capacity. Fully illustrated and diagrammed.

396 LUBRICANTS, QUENCHING OILS, ETC.

E. F. Houghton & Co.—Product index of Houghton processing and maintenance products gives brief description with product names covering lubricants, coolants, quenching oils, heat-treating products, and leather belting and packings.

397 WATER CONDITIONING

Permutit Co.—Latest Development—Effluent from Hot Lime Soda Softener Reduced to Zero Hardness by Permutit Hot Zeolite Process No. 3507. The hot zeolite process which replaced second-stage phosphate treatment is described and illustrated.

398 PACKAGED STEAM PLANT

Superior Combustion Industries, Inc.—Catalog No. 403 contains facts about Superior steam generators. Its 22 illustrated pages demonstrate the "how" and "why" of Superior steam generators' long-lived, high efficiencies. Easily-read tables provide engineers with essential data and dimensions.

399 PUMPS

Oberdorfer Foundries, Inc., Industrial Pump Div.—Catalog portrays limitations of six lines of small corrosive-resistant pumps widely used in industry throughout the world. International Series I—Bronze precision rotary gear type. International Series II—Bronze, close-coupled, motor-driven, rotary-gear type. International Series III—carbon block, rotary-gear type. International Series IV—bronze rubber impeller type. Oberdorfer Standard Gear Pump—bronze rotary gear type. Oberdorfer Standard Centrifugal Pump—bronze centrifugal type.

400 WORM GEARS

Cone-Drive Gears Div., Michigan Tool Co.—Quick reference bulletin 789-50 covers standard double-enveloping gear sets, reducers, fan cooling attachments, mountings, and shafts carried in stock. The bulletin has a condensed table indicating the wide range of horsepower which can be carried by these ultra-compact gear sets and reducers. Horsepower ranges from fractional to over 500 hp. Ratios range from 5/1 to 70/1. Center distances range from 2 to 18 in., corresponding to gearsets of from 3 in. to close to 30 in. in conventional gear designs from the standpoint of mechanical load carrying capacity.

401 WATER CONDITIONING

Permutit Co.—Mixed Bed Demineralizer booklet No. 3591 describes the operation, states advantages, and suggests when this type of unit should be used. Unit delivers "Conductivity Water," total electrolytes less than 0.5 ppm and silica below 0.1 ppm.

The "Buyer's Catalog Guide" offers readers of MECHANICAL ENGINEERING an opportunity to secure advertisers' latest industrial literature available. In this issue there are 401 items to make selections from. For convenience an index may be found on pages 41 and 42. Select desired catalogs by number, fill in coupon on page 42 and mail promptly. *(Must be mailed on or before date given on coupon.)*

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G-E Adjustable-speed Drive Increases Ozalid Machine's Versatility, Accuracy

Reproduction machine's speed easily set for various kinds of paper, with electronic Thy-mo-trol* drive

Reproducing "short-order" copies of virtually any kind of printed matter, drawings, etc. is the function of Ozalid's new Ozamatic machine. One secret of the versatility of this and all other Ozalid machines is G-E Thy-mo-trol drive.

Speed of the machine must be matched to the type, weight, and thickness of paper being used in each copying job. The simplicity of the Thy-mo-trol drive permits the operator to make the proper speed adjustment quickly and accurately simply by turning the speed-control knob. Thus, the machine can handle a great variety of copy jobs quickly, and with little training required for the operator.

The electronic precision of Thy-mo-trol, one of G.E.'s adjustable-speed family, has helped many equipment manufacturers improve the performance of their machines by greatly increasing their versatility and accuracy. And G-E adjustable-speed drives are helping manufacturers in every field to increase production with improved quality control, saving scarce materials, cutting rejects, and making existing machinery more flexible. One or more of this versatile drive family can probably do the same for you. Best way to find out is to mail the coupon below.

ON THE OZAMATIC, Ozalid's new desk-top machine, the operator quickly and accurately selects the desired speed—from 0 to 30 feet per minute—simply by turning the speed-control knob. Electronic Thy-mo-trol drive—standard equipment for Ozalid who pioneered its use on reproduction machines—does the rest.

WHICH DRIVES ARE BEST FOR YOU?

This 26-page manual will help you decide. It shows you how to go about selecting the *right* drive. The handy drive chart included is worth your detailed study. Bulletin GEA-5334. Check here ☐

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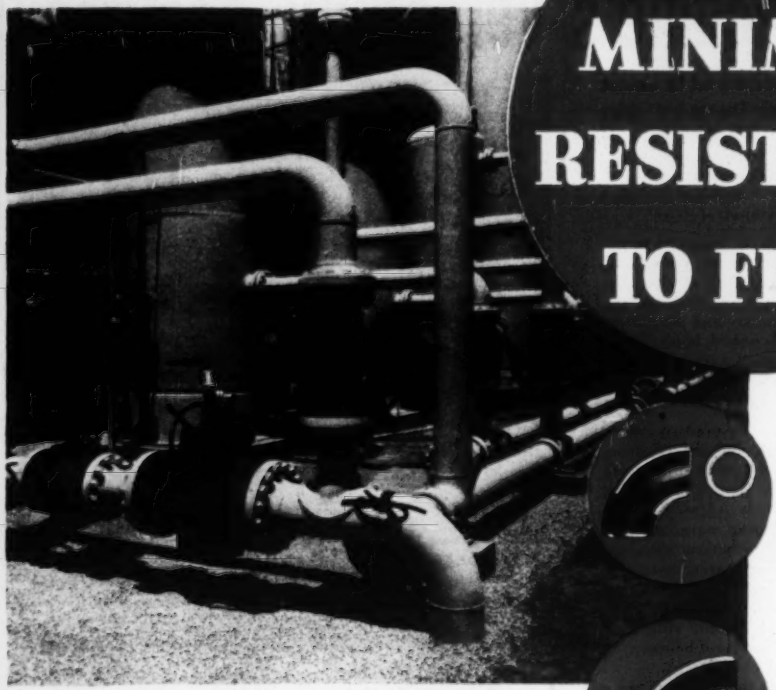
** Thy-mo-trol is the General Electric Company's registered trademark for its electronic motor-control system.*

Headquarters for ELECTRICAL ADJUSTABLE-SPEED DRIVES

GENERAL ELECTRIC

Grinnell Welding Fittings for

MINIMUM RESISTANCE TO FLOW



Grinnell Welding Fittings on towers of natural gasoline plant.

Any qualified welder can make welds quickly and easily with Grinnell welding fittings. These fittings are made by a hydraulic forging process that assures uniform wall thickness at all points and true circularity throughout. Of seamless, one-piece construction, they can be cut at any angle to match up with standard weight, extra strong and heavier wall pipe in I. D. or O. D. sizes. Pressure-temperature ratings are equal to or greater than those of seamless steel pipe. Grinnell welding fittings are process stress-relieved.

Full data on the complete line of Grinnell carbon steel butt welding fittings and forged steel flanges is contained in the Grinnell Welding Fittings Catalog.

SEND FOR THIS CATALOG

TRUE CIRCULAR SECTION

True circular section at all points makes a Grinnell fitting easy to align and weld . . . no distortion or flattening to affect flow adversely.

FULL EFFECTIVE RADIUS

Pressure loss through Grinnell welding elbows is held to a minimum because of the full, effective sweep of the radius.

SMOOTH, CLEAN INSIDE SURFACE

Grinnell fittings have uniformly smooth inner walls . . . no waves or ridges to cause turbulence or accelerate erosion or corrosion. No pockets to trap solids or foreign matter.

EASY, SWEEPING TURNS

In Grinnell welding tees, the corners where the outlet joins the run are well-rounded and perfectly smooth to minimize resistance to flow and to prevent trapping.

GRINNELL

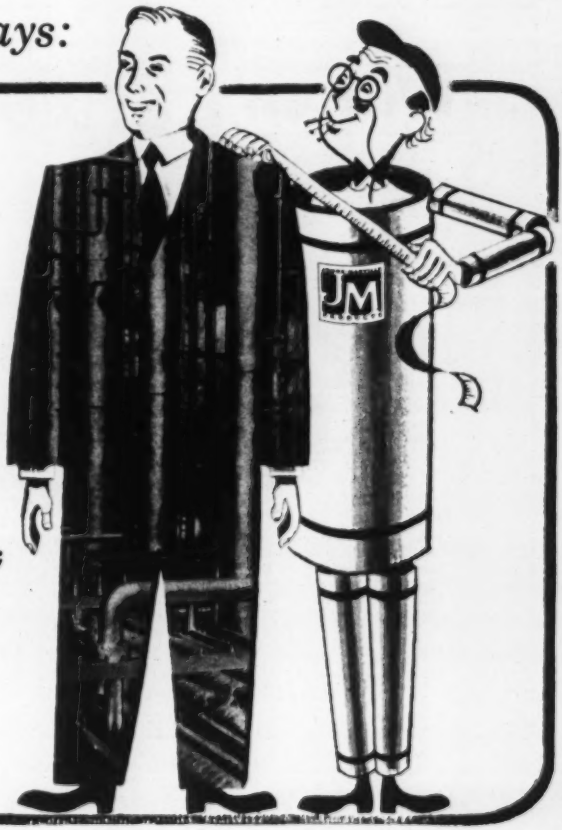
WHENEVER PIPING IS INVOLVED

Grinnell Company, Inc., Providence, R. I. Warehouses: Atlanta • Billings • Buffalo • Charlotte • Chicago • Cleveland Cranston • Denver • Fresno • Kansas City • Houston • Long Beach • Los Angeles • Milwaukee • Minneapolis • New York • Oakland Philadelphia • Pocatello • Portland • Sacramento • St. Louis • St. Paul • San Francisco • Santa Barbara • Seattle • Spokane

Mr. Insulation says:

"Buying insulation is like buying a suit of clothes:

—the better the materials; the more expert the tailoring, the better your investment"



Just as no one cloth can be used for every suit of clothes, there is no one raw material that can serve as the ideal insulator for every industrial insulation job.

For this reason, Johns-Manville manufactures a wide variety of industrial insulations—of asbestos and other raw materials—each of which is designed for a special purpose. These insulations span the entire range of temperatures from 400 F below zero to 3000 F above.

But, again, there is much more to the story of insulations than their manufacture. In order to get the greatest return from your investment in them, they must be expertly engineered to the job, and then skillfully applied.

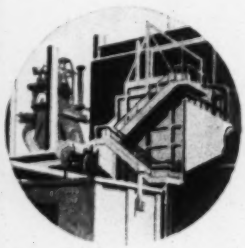
Johns-Manville makes available to you the service of experienced insulation engineers, and highly skilled mechanics for the proper application of Johns-Manville insulations.

If you are contemplating an insulation installation for your plant, it will pay you to look into this Johns-Manville insulation service. For further information just write Johns-Manville, Box 60, New York 16, N. Y.

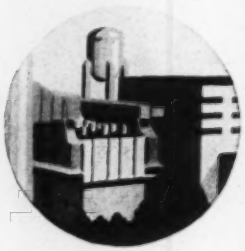
Johns-Manville *first in* **INSULATIONS**

War on waste!

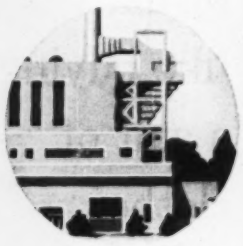
American industry is continually searching for new ways to stop waste and increase production and efficiency. A good example of this is the Koppers-Elex electrostatic precipitator. Shown below are a few typical ways industry uses them to combat waste . . .



BLAST FURNACE GAS must be cleaned before it can be used as a fuel. Koppers-Elex electrostatic precipitators clean this gas to residuals as low as .002 grain per cubic foot.



FLUE GASES from recovery boilers in pulp mills contain valuable materials. Koppers-Elex electrostatic precipitators recover several hundred thousand dollars worth of these materials yearly.



FLY ASH from power plants and factories may drop a blanket of dust extending three to five miles. Koppers-Elex electrostatic precipitators stop this nuisance and preserve public good will.

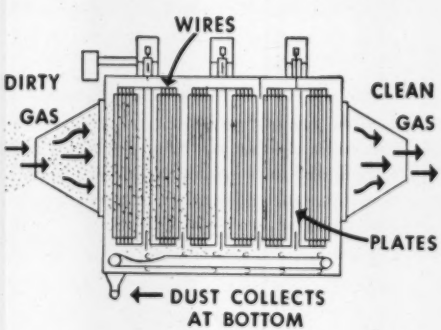
Guaranteed: All Koppers-Elex electrostatic precipitators are guaranteed to equal or better (under tests made by your own personnel) any efficiency or residual content you specify.

ENGINEERS! You should know about these six design features of Koppers-Elex electrostatic precipitators!

KOPPERS has made sweeping improvements in electrostatic precipitator design! For example, double chambers eliminate expensive by-pass systems and the resultant loss of materials during inspection or maintenance. And re-entrainment is sharply reduced because rapping is sectionalized.

Successive collection zones are separately energized to provide maximum voltage for highest collection. And because each field is, in effect, a separate precipitator, the outage of one field *does not stop* gas-cleaning action. In addition, completely enclosed and compact "package" mechanical or vacuum tube power packs simplify installation and operation.

Another exclusive Koppers feature is the drag scraper which provides continuous dust removal, eliminates plugged hoppers and prevents bothersome dust build-up. For detailed information on recovery, gas-cleaning or nuisance abatement results write today to: Koppers Company, Inc., Precipitator Dept., 224 Scott Street, Baltimore 3, Md.



If you have a gas-cleaning problem, write today to: Koppers Company, Inc., Precipitator Dept., 224 Scott St., Baltimore 3, Md.

KOPPERS

Koppers-Elex ELECTROSTATIC PRECIPITATORS

DIAMOND
SOOT BLOWERS

Meet the challenge of HIGH BOILER AVAILABILITY

The greater emphasis being placed on high boiler availability indicates the equal importance of high soot blower availability. The first can be limited by the second.

No other power plant equipment takes the "beating" to which soot blowers are daily subjected. Elements are exposed to repeated, sudden and severe thermal shock . . . to extremes of temperature, erosion and corrosion.

Diamond has long paid particular attention to "high availability" in its research . . . in the design, in the selection of materials and in the manufacture of all Diamond Soot Blowers. That they excel in this direction also is attested by their performance records . . . and by the preference they have long enjoyed among the most critical users of boiler equipment. The next time you need soot blowers, it will pay you well to select Diamond Soot Blowers.

DIAMOND POWER SPECIALTY CORP.
LANCASTER, OHIO
Diamond Specialty Limited • Windsor, Ontario

DIAMOND Model IK Long Retracting Soot Blower with mechanically operated valve. Air motor operated unit shown; also available electric motor operated.

DIAMOND Model IR Short Retracting Soot Blower. Electric operation shown; also available for manual or air operation.

DIAMOND Model A2E Automatic Air Puff Soot Blower.

DIAMOND Model G98 Soot Blower. Air operation shown; also available for manual or electric operation.

There is a DIAMOND Soot Blower . . . for Every Boiler Cleaning Requirement

You've got a Winning Combination

...the New

TRADE **LESLIE** MARK

DOUBLE SEATED DIAPHRAGM CONTROL VALVES

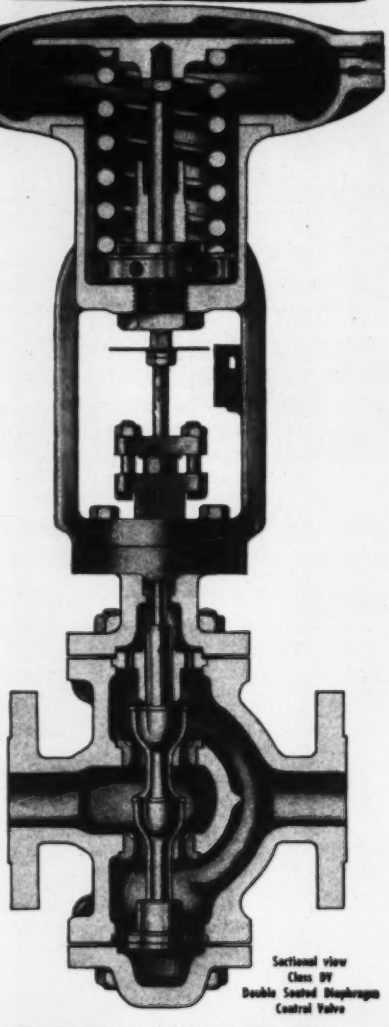
Calling a spade a spade you've got a "royal flush" of features in these new Valves designed for use with control instruments.

Their "Flow-Line" Contoured Bodies have ISA standard face-to-face dimensions and high capacity, low turbulence and minimum body pressure drop characteristics.

A new type, top and bottom guided construction is self-aligning and non-binding regardless of uneveness of bolt tightening.

Standard, integral stellited seating surfaces are recommended for steam service to reduce seat ring thread corrosion. Renewable, interchangeable seat rings also furnished where desired and may be easily replaced without removing valve body from the line. Elaborate grinding at high temperatures is completely eliminated.

With these Valves, you get as *standard equipment*, features heretofore only obtainable in expensive, specially designed valves.



Sectional view
Class DV
Double Seated Diaphragm
Control Valve

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Atlanta, Ga.	Cleveland, Ohio	Houston, Texas	Milwaukee, Wis.	Pittsburgh, Pa.	Seattle, Wash.
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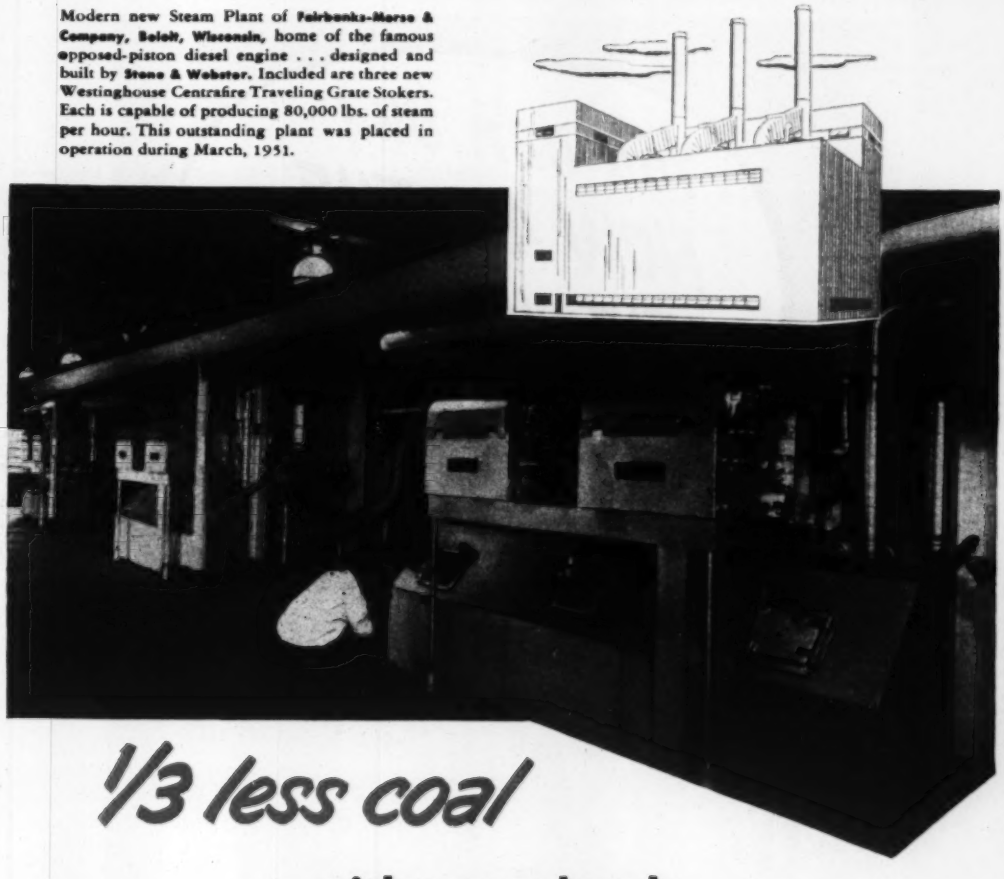
***WRITE FOR* Bulletin 513**

ESTABLISHED 1900
LESLIE CO.
1707

287 Grant Avenue, Lyndhurst, New Jersey

FLOATLESS LEVEL CONTROLS • PRESSURE REDUCING VALVES • PRESSURE CONTROLLERS
SELF CLEANING STRAINERS • PUMP GOVERNORS • TEMPERATURE REGULATORS
• AIR HORNS • STEAM WHISTLES

Modern new Steam Plant of **Fairbanks-Morse & Company, Beloit, Wisconsin,** home of the famous opposed-piston diesel engine . . . designed and built by **Stone & Webster.** Included are three new Westinghouse Centrafire Traveling Grate Stokers. Each is capable of producing 80,000 lbs. of steam per hour. This outstanding plant was placed in operation during March, 1951.



1/3 less coal

with same load

Three Westinghouse Centrafire® Stokers with Traveling Grate, installed at the new Fairbanks-Morse Steam Plant, are establishing an impressive record of efficient and economical operation. Previous stokers operating under identical temperature and load conditions burned approximately 50% more coal than now is required by the new Westinghouse Centrafire.

Each pound of coal now produces more steam due to more complete combustion with a minimum of excess air. Accelerated response to changing steam loads makes operation easy. Requirements for operating and maintenance personnel have been cut considerably.

You can have the operating economy . . . flexibility . . . and reliability of a Westinghouse Stoker with any boiler of your choice. To get the full story, phone your nearest Westinghouse Stoker Application Engineer, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa. J-50533

YOU CAN BE SURE...IF IT'S Westinghouse

STOKERS

In these days when so many materials are hard to find, it is a pleasure to tell you that felt is plentiful and free of all restrictions.

American can fill your orders, large or small, for either roll felt or felt parts cut to your specifications.

Sales Offices are maintained by American in all sections of the country. Get in touch with the one nearest you. You will receive immediate attention, and delivery will be rapid.

And remember that the Engineering and Research Laboratories at Glenville are ready to collaborate with you on such matters as the selection and specification of felt and new allied products to meet your specific needs.

For all the felt you need—call American!

American Felt Company

TRADE MARK

GENERAL OFFICES:
50 GLENVILLE ROAD, GLENVILLE, CONN.

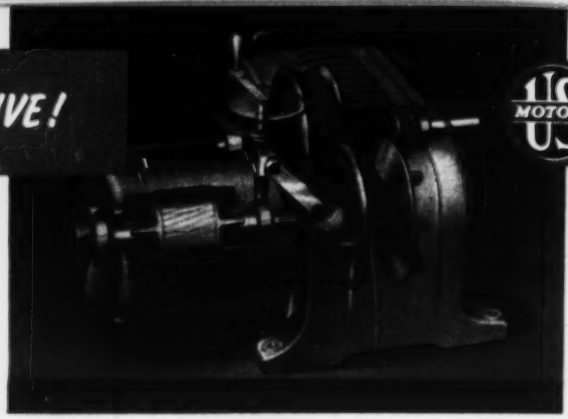
SALES OFFICES: New York, Boston, Chicago, Detroit, Cleveland, Rochester, Philadelphia, St. Louis, Atlanta, Dallas, San Francisco, Los Angeles, Portland, Seattle, San Diego, Montreal—PLANTS: Glenville, Conn.; Franklin, Mass.; Newburgh, N. Y.; Detroit, Mich.; Westerly, R. I.—ENGINEERING AND RESEARCH LABORATORIES: Glenville, Conn.

every speed with Varidrive

You simply turn a control handle! Instantly the speed of the Varidrive changes to the exact rpm you need. The productive scope of your powered machines and equipment will be greatly increased. Your operators can produce more output every hour.

U.S. Varidrive Motors

GO MODERN—GO VARIDRIVE!



US MOTORS

Get any RPM

YOU GET THESE EXTRA ADVANTAGES IN THIS MIRACLE MOTOR

ANY SPEED
BY TURNING A DIAL

INCREASES PRODUCTION
UP TO 30%

NO BELTS TO SHIFT
NO GEARS TO CHANGE

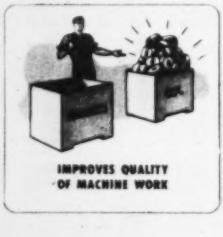
ELIMINATES EXTRA
CONTRAPTIONS

REDUCES FATIGUE
GIVES WORKER INCENTIVE

CHANGES SPEED TO
FIT WORKER'S RHYTHM

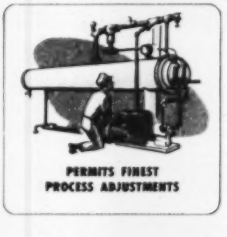
GIVES EXACT SPEED
FOR SIZE OF WORK

LOCALLY OR
REMOTELY CONTROLLED



IMPROVES QUALITY
OF MACHINE WORK

COMPACT—CAN INSTALL
DIRECT ON MACHINE



PERMITS FINEST
PROCESS ADJUSTMENTS

VARIOUS TYPES
2 TO 10,000 RPM

Machines with only 1, 2 or 3 speeds can't give maximum output. *Keep pace with progress.* Take full advantage of your machine's unused production. Give it infinite variations of speeds best suited to the job and to the operator's ability.

Many users of U. S. Varidrive Motors obtain 10 hours' production in 8 because the operator can select just the right speed for each operation. He gets it *instantly* by merely turning a control dial. He speeds up his work to synchronize with his rhythm of movement. He sets the speed faster for quick work, slower for very precise operations. *Install Varidrives and save.*

MAIL COUPON FOR VARIDRIVE BULLETIN

U. S. Electrical Motors, Inc.
Los Angeles 54, Calif. (Box 2058) or Milford, Conn.

Send VA Varidrive Motor Bulletin

NAME_____

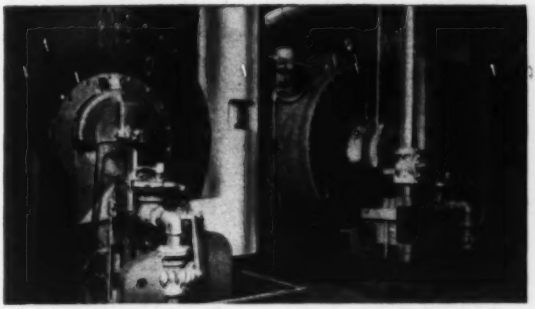
COMPANY_____

ADDRESS_____

CITY_____ ZONE____ STATE_____

U. S. VARIDRIVE MOTOR

"The Boiler-Room? — On the Roof, Sir"



The "First of Tulsa" Boiler Room — Two Cleaver-Brooks 200 hp. Gas Fired Boilers

Boiler-Room in the SKY..

Boiler Room Directly Behind Roof Sign

FIRST NATIONAL BANK OF TULSA
TULSA, OKLAHOMA

Carson & Lundin, *Architects*
Gaynor & Albright
Mechanical Engineers
John W. Harris & Associates
Supervisory Contractors
Manhattan Construction Co.
General Contractor
C. Wallace Plumbing Co.
Heating, Ventilating & Air Conditioning Contractor

FURTHER PROOF OF CLEAVER-BROOKS BOILER FLEXIBILITY

The new $6,000,000 First National Bank of Tulsa, one of the finest buildings in the Southwest, is heated with Cleaver-Brooks Self-Contained Steam Boilers.

For very good reasons the boiler-room was placed at roof level. (Boiler-room is directly behind roof sign at top of building, instead of conventional location in basement.) First, since it was a bank building, basement space was extremely valuable for vaults, storage, and air conditioning equipment. Then, too, with the fresh air intake on the top of the building, a considerable amount of piping was eliminated by placing the boilers at the same point. Since Cleaver-Brooks boilers require only a simple vent for carrying off combustion gases, long stack runs were eliminated, leaving additional valuable space within the building.

These are just a few of the many reasons why Cleaver-Brooks boilers were specified. Being completely self-contained and compact in design, requiring minimum head room and floor area, Cleaver-Brooks boilers presented no installation problem.

Cleaver-Brooks Self-Contained Boilers are available for oil, gas, combination oil and gas firing, 15 to 500 hp, 15 to 250 p.s.i., for heating and processing loads. Write for the catalog.

CLEAVER-BROOKS COMPANY
Dept. D-318 E. Keefe Avenue • Milwaukee 12, Wis.

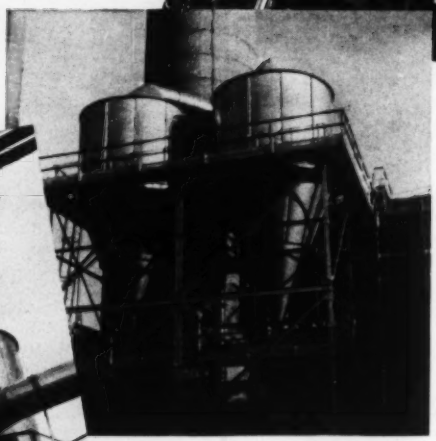
Cleaver-Brooks
STEAM BOILERS
The First and Finest of their Class

Norblo

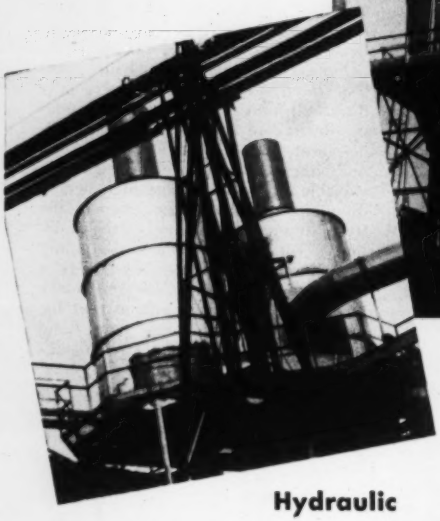
helps you to achieve outstanding efficiency in dust and fume collection

with these three important systems

Automatic Bag Type



Cyclone



Hydraulic

Norblo *Portable* Dust Collecting Units, bag or filter types, give you localized dust control. Comply with all state and city codes. Three sizes, six rating selections from 300 C.F.M. to 1350 C.F.M. Write for Bulletin 163-5.

Dust and fume control ranks high among the facilities considered necessary in modern industrial operations. Now you figure the economy of safeguarding against explosions — of increasing the general efficiency of your plant — of salvaging valuable fumes and dusts.

Norblo makes three principal types of collection systems — engineers each installation from first hand experience of 40 years in many industries. High-efficiency equipment having the correct factors to suit your needs includes the Norblo guarantee of performance, economy and low maintenance. Before you decide on any fume or dust collection equipment consult the Norblo engineering department.

THE NORTHERN BLOWER COMPANY

Engineered Dust Collection Systems for All Industries

6421 BARBERTON AVE. • CLEVELAND 2, OHIO

ANOTHER EXAMPLE OF VERSATILITY..

DRAVO *Counterflo* HEATERS*

SERVE BUFFALO TRANSIT COMPANY IN 3-WAYS

*DIRECT-FIRED

1. **COMFORT HEATING**—in winter. Four Dravo Heaters recirculate warm air over a 33,600 sq. ft. floor area in three integrated buildings . . . each heater has maximum air throw . . . provides uniform heat for personnel at working levels, despite opening and closing of doors to permit buses to enter and leave.

2. **VENTILATING**—in summer. Heater fans can be used alone to recirculate air and keep working conditions comfortable in hot weather. The Dravo Heaters are mounted horizontally and suspended from roof trusses to save valuable floor space.

3. **DRYING**—all year 'round. One heater, in addition to these other functions, dries buses with warm air as they come off the wash rack.

DRAVO HEATERS OFFER YOU...

- **Low initial cost**—users report savings of 30% to 60% over standard "wet-type" systems.
- **Easy installation**—no duct work . . . need only fuel, exhaust and electrical connections.
- **Low operating cost**—burns gas or oil . . . easily converted . . . minimum efficiency 80%.
- **Long life — low maintenance**—rugged construction . . . stainless steel combustion chamber eliminates refractory lining.
- **Heat where you need it**—right in the working zone . . . roof heat losses reduced.
- **Automatic operation**—heater looks after itself . . . requires only occasional attention.

MAIL THIS COUPON FOR MORE INFORMATION...

Heating Department, Dravo Corporation
Dravo Building, Fifth and Liberty Avenues
Pittsburgh 22, Penna.

I would like more information about Dravo *Counterflo* Heaters. Please send me Bulletin No. UV-523-24

Name_____

Title_____

Company_____

Address_____

City_____ Zone_____ State_____

DRAVO

CORPORATION

PITTSBURGH • ATLANTA • BOSTON • CHICAGO • CLEVELAND
DETROIT • NEW YORK • PHILADELPHIA

Sales Representatives in Principal Cities

Manufactured and sold in Canada by Marine Industries, Ltd., Sorel, Quebec. Export Associates: Lynch, Wilde & Co., Washington 9, D.C.

Put FORCE behind your vibration testing

...more than 2500 pounds of it with this big MB exciter

POWER AND ENDURANCE feature this new MB Model C25 Vibration Exciter – today's largest and most dependable electromagnetic shaker.

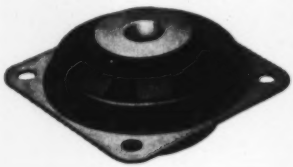
It has already proved its heavy-duty capacity in a number of important military vibration testing applications. In frequencies from 3 to 500 cps, it easily develops required forces to produce accelerations of 15g with 100 lb table load or 20g with 60 lb table load, for example.

Like all MB Exciters, Model C25 Shaker provides easy, accurate, continuous control of force and frequency. It allows "scanning" for response to vibration of parts under test. Electrically interlocking controls assure trouble-free operation. Automatic cycling control available to meet specifications of MIL-E-5272.

Vibration testing shakes out troubles before they start. It's not only a "must" for much military equipment, but also a good idea for *any* product. If you'd like to know more about it, why not contact "headquarters" for vibration engineering – MB! You'll find the help and advice you're seeking.

APPROVED MOUNT FOR ISOLATING VIBRATION

This Type 17 MB Vibration Isolator incorporates a principle first achieved by MB in mountings. It has equal spring rates in all directions in order to isolate all modes of motion with equal efficiency. Available for loads from 0.5 to 100 lbs to meet MIL-I-5432 (AN-I-16a) specification on vibration isolation. Write Dept. 4 for details.



MORE DETAILS

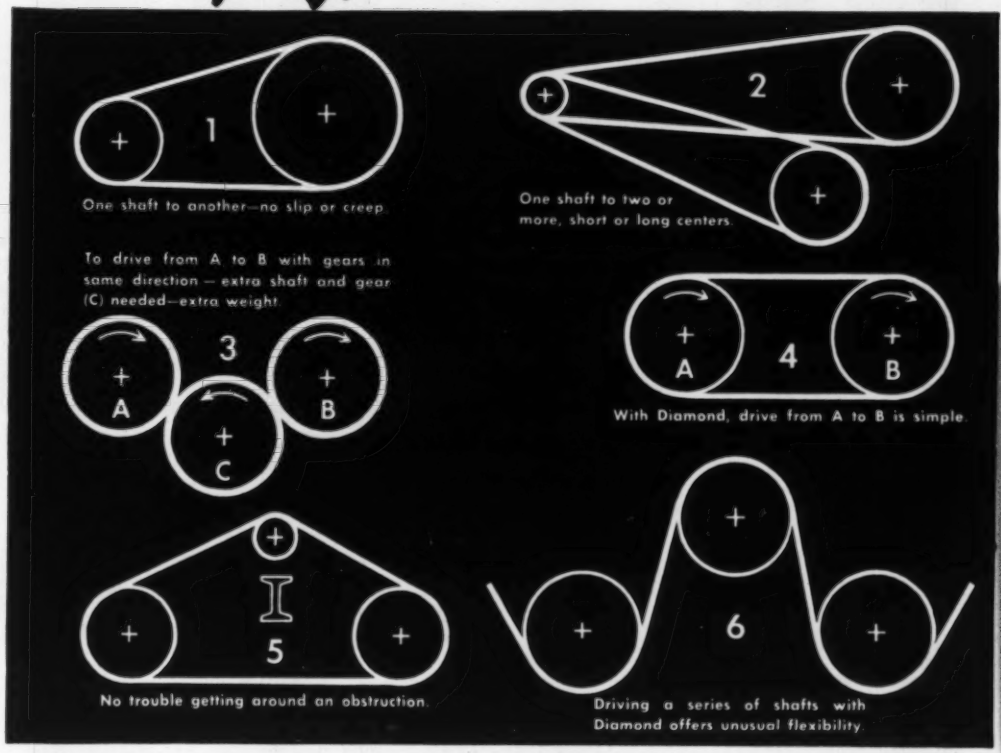
New bulletin containing specifications, operational information and helpful hints on usage, is now available on the complete line of MB Vibration Exciters which includes models from 10 lbs to 2500 lbs force output. Ask for **Bulletin No. 1-VE-4.**

THE MB MANUFACTURING COMPANY, INC.
1060 STATE STREET, NEW HAVEN 11, CONN.

PRODUCTS AND EQUIPMENT TO CONTROL VIBRATION ... TO MEASURE IT ... TO REPRODUCE IT

DIAMOND ROLLER CHAINS

Simplify Power Transfer


1
One shaft to another—no slip or creep.
2
One shaft to two or more, short or long centers.
To drive from A to B with gears in same direction — extra shaft and gear (C) needed—extra weight.
3
A
B
C
4
A
B
With Diamond, drive from A to B is simple.
5
No trouble getting around an obstruction.
6
Driving a series of shafts with Diamond offers unusual flexibility.

REDUCE COSTS AND WEIGHT, FACILITATE ASSEMBLY

● The few examples outlined above show the flexibility of Diamond Roller Chain application—and how simplification is attained.

Assembly and disassembly are simple—drives from one shaft to another or to several other shafts present no problem. Compare drawings (3) and (4) above. To rotate two shafts in the same direction by gears requires a third gear and shaft, while the Diamond Chain as in (4) does the job whether the center distances are short or long and regardless of the speed ratio. And there is no slippage.

In (5) the ease of getting around an obstruction is illustrated and (6) shows how a series of shafts can be positively rotated with sprockets of various sizes to provide the speed of rotation desired.

Diamond Roller Chains do these jobs and many others with long-life, low-cost dependability, for every link is precision made by workmen skilled in chain making for over 60 years.

DIAMOND CHAIN COMPANY, Inc.

Dept. 413, 402 Kentucky Avenue Indianapolis 7, Indiana

Offices and Distributors in All Principal Cities

Refer to the classified section of your local telephone directory under the heading CHAINS or CHAINS-ROLLER

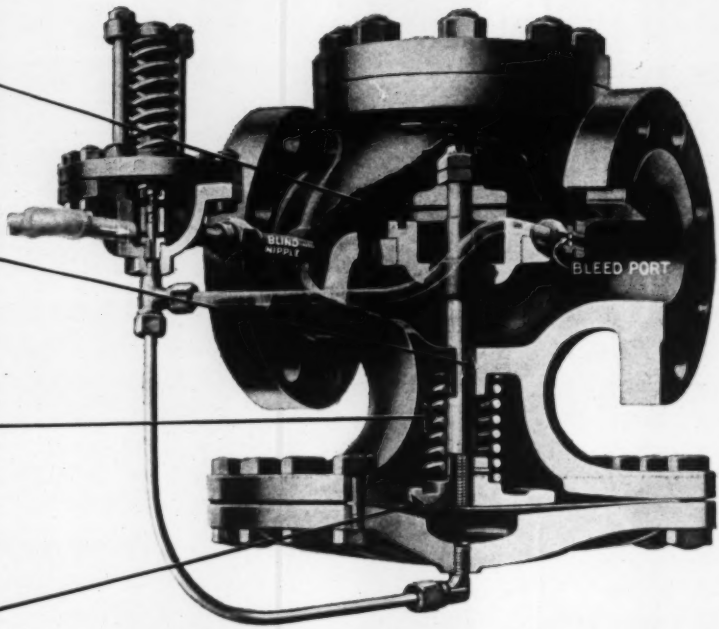
WHY Spence Regulators Outlast The Field

SECO METAL SEATS AND DISCS — Durable SECO Metal resists wiredrawing. More than *twenty years of experience* in thousands of installations has failed to produce a single case where SECO Metal has been cut by steam.

PACKLESS CONSTRUCTION — All Spence main valves and most pilots are built without stuffing boxes. This minimizes friction . . . eliminates much time-consuming maintenance.

SPRING OUT OF PATH OF STEAM — The spring in the Spence Regulator is out of the path of the steam or other fluid flowing through the valve. It operates at low unit stress for exceptionally long life.

LARGE BALANCED DIAPHRAGM—Spence metal diaphragms, under usual conditions, never require replacement. Spence Regulators have few moving parts and those few are ruggedly constructed and seldom require attention.



Spence Type EQ back pressure regulator-operation of main valve is controlled by a sensitive pilot to regulate the initial pressure. Same pilot is used with all sizes of main valves.

The features shown above explain why you profit on every important count with Spence Pressure and Temperature Regulators.

Learn more about these and many other advantages of Spence Regulators by sending for Bulletin 350.

DURABILITY — Spence Regulators perform dependably year after year.

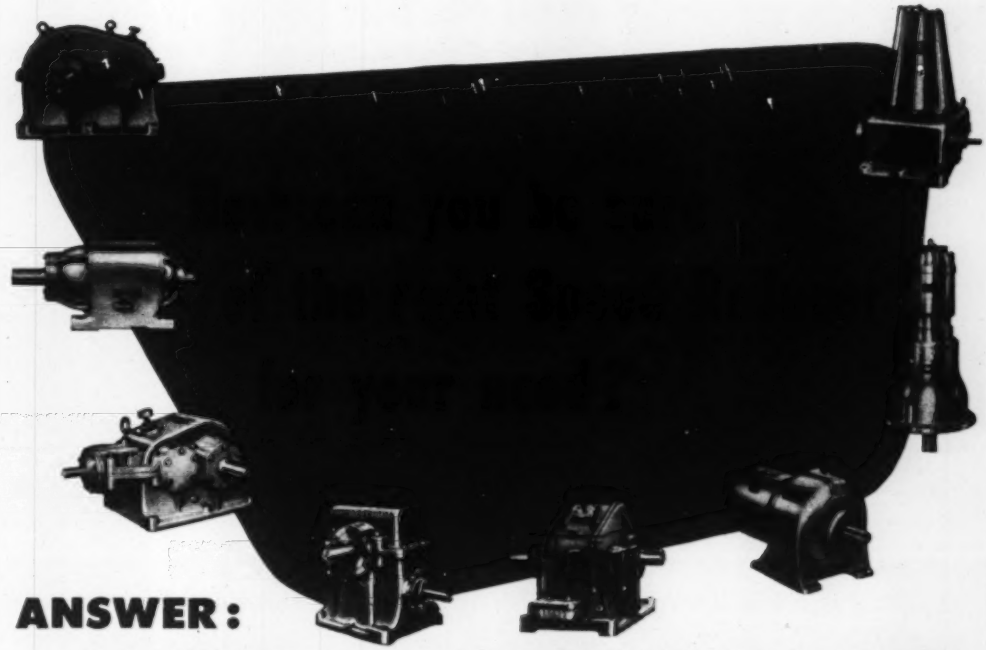
ACCURACY — You can be sure of accurate control for the life of the regulator.

MAINTENANCE — You don't need expensive repairs or special maintenance. That means less down-time, less time and money wasted on replacement of parts.

SB-110

SPENCE ENGINEERING COMPANY, INC.
WALDEN, NEW YORK

Spence



ANSWER:

CONSULT THE MAKER OF ALL TYPES

for an unbiased recommendation

PHILLIE GEAR®

When you get a recommendation from Philadelphia for the application of a speed reducer to fit your drive you can be sure it is the *best* type unit you can get for that need. We make *all types and sizes* so our recommendations are not biased through a limited selection but are absolutely impartial.

Thousands of Philadelphia Speed Reducers are transmitting power dependably and economically in all lines of industry and in all parts of the world. As a result, we have gained a thorough understanding of industry's varied drive requirements. That experience has been applied to the design and construction of all our speed reducers and is a fundamental reason for the continuing preference for Philadelphia products.

OUR 60™ ANNIVERSARY

Whatever your power transmission problem it will pay you to talk it over with Philadelphia.

Catalogs are available on each type Philadelphia Speed Reducer, GearMotor and MotoReducer. Write on your business letterhead and ask for the one you need.

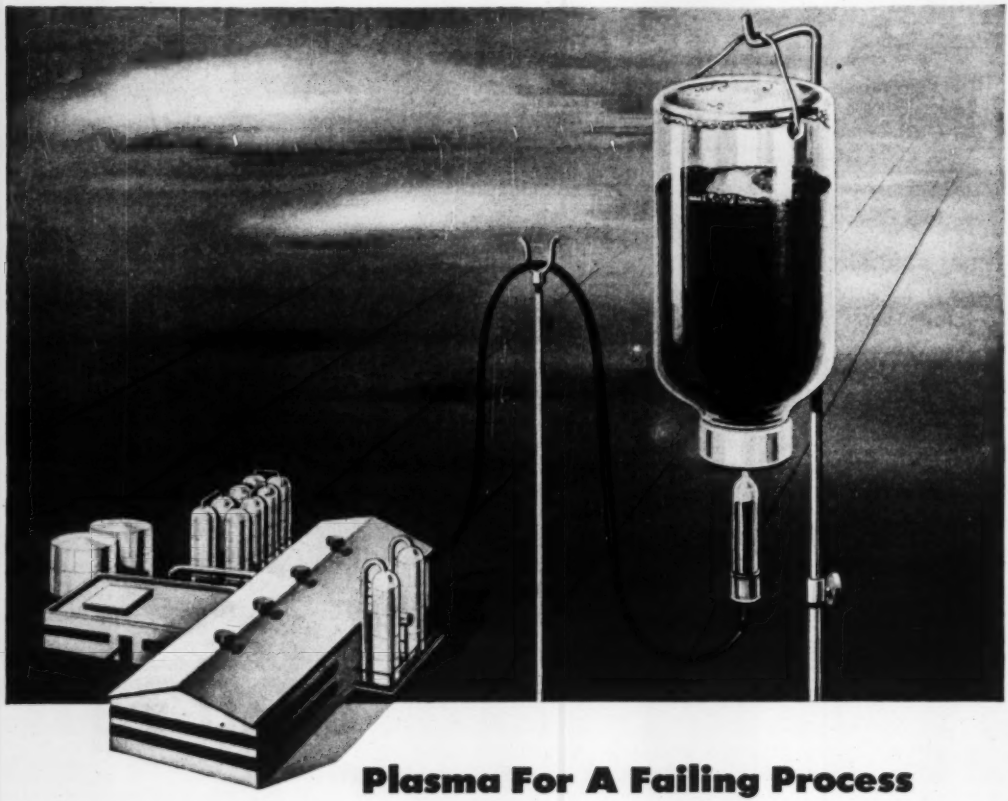
Shown counterclockwise above—Herringbone, Planetary, Spiral Bevel, Worm Gear Reducers, Speed Increaser, GearMotor, Vertical MotoReducer, Steeple Type Worm Reducer.

Philadelphia Gear Works, INC.

ERIE AVE. AND G ST., PHILADELPHIA 34, PA.

NEW YORK • PITTSBURGH • CHICAGO • HOUSTON • LYNCHBURG, VA.

Industrial Gears and Speed Reducers
LimiTorque Valve Controls



Plasma For A Failing Process

Throughput usually suffers when any part of your process gets too weak to keep up with the rest of your system. Here's how one company we know prevented such a problem.

Chlorinated hydrocarbons for use in plastics had to be weighed. Test-tube accuracy without metallic pick-up, contamination or discoloration was essential. Stability had to be maintained with sub-zero temperatures.

The answer: jacketed weigh tanks on suspended scales. Passage between shells gave ample circulation for coolant, while a nickel-clad steel inner shell assured purity, gave fast, uniform heat transfer. Easy low-cost maintenance and long life also resulted.

Where did this solution come from? It was the result of cooperative development between the engineering staffs of progressive Equipment Builders, process engineers and materials suppliers. In developing such equipment, these *better* builders regularly turn to Lukens for its knowledge of materials, as well as its wide range of low-cost clad steels.

Even with new equipment hard to get, these builders can often recondition what you have for better, more profitable production. For their names, write us today, explaining your problem. Manager, Marketing Service, 402 Lukens Building, Coatesville, Pennsylvania.

LUKENS

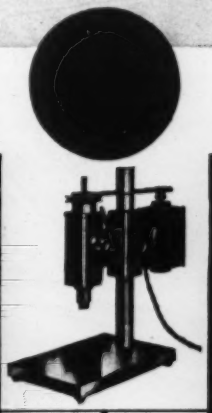
LUKENS STEEL COMPANY

WORLD'S LEADING PRODUCER OF SPECIALTY STEEL PLATE • PLATE SHAPES • HEADS • CLAD STEELS

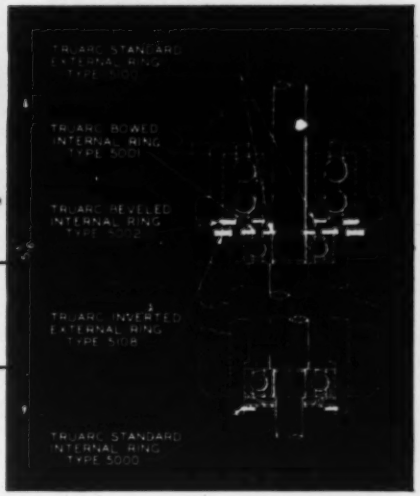
WALDES TRUARC RETAINING RINGS GIVE PRECISION FASTENING

save $3.50 per unit in redesign of miniature Spindle Assembly

BEFORE. 4 threaded retainers required to hold parts of drill press assembly together. Machining of threads was slow, costly...required skilled labor. Threaded retainers took up much space.



AFTER. 6 Truarc Rings require only 6 simple grooves...lock parts firmly together for life of unit. Quick, easy to apply...no skilled labor needed. Length of spindle assembly cut 9/16".



In Philips & Hiss Company's new Miniature Drill Press, tolerances are critical . . . compactness, important. By using 6 Truarc Retaining Rings, they cut the length of the spindle assembly 9/16". The machine is more securely assembled, smaller, lighter. What's more—Truarc Rings eliminated threaded retainers and mating threads, saving 68 minutes of machining and skilled assembly time, or a saving of $3.50 per unit.

Redesign with Waldes Truarc Rings and you, too, will save on assembly time, improve product performance, facilitate easier servicing of whatever you make.

Wherever you use machined shoulders, bolts, snap rings, cotter pins, there's a Waldes Truarc Retaining Ring designed to do a better job of holding parts together. They're precision-engineered . . . quick and easy to assemble and disassemble. They give a never-failing grip, can be used over and over again.

Find out what Truarc Rings can do for you. Send your blueprints to Waldes Truarc engineers for individual attention, without obligation.

6 TRUARC RINGS (5 different types)
EACH SOLVED A SPECIAL PROBLEM

STANDARD EXTERNAL RING } forms secure
STANDARD INTERNAL RING } shoulder, gives tight pressure fit when installed in a groove.

INVERTED EXTERNAL RING
Provides uniform shoulder for curved abutting surfaces.

BOWED INTERNAL RING
Takes up end-play resiliently, accommodates accumulated tolerances.

BEVELED INTERNAL RING
Takes up end-play rigidly, remains secure against thrust and vibration.

SEND FOR NEW BULLETINS ➡

WALDES

TRUARC

REG. U. S. PAT. OFF.

RETAINING RINGS

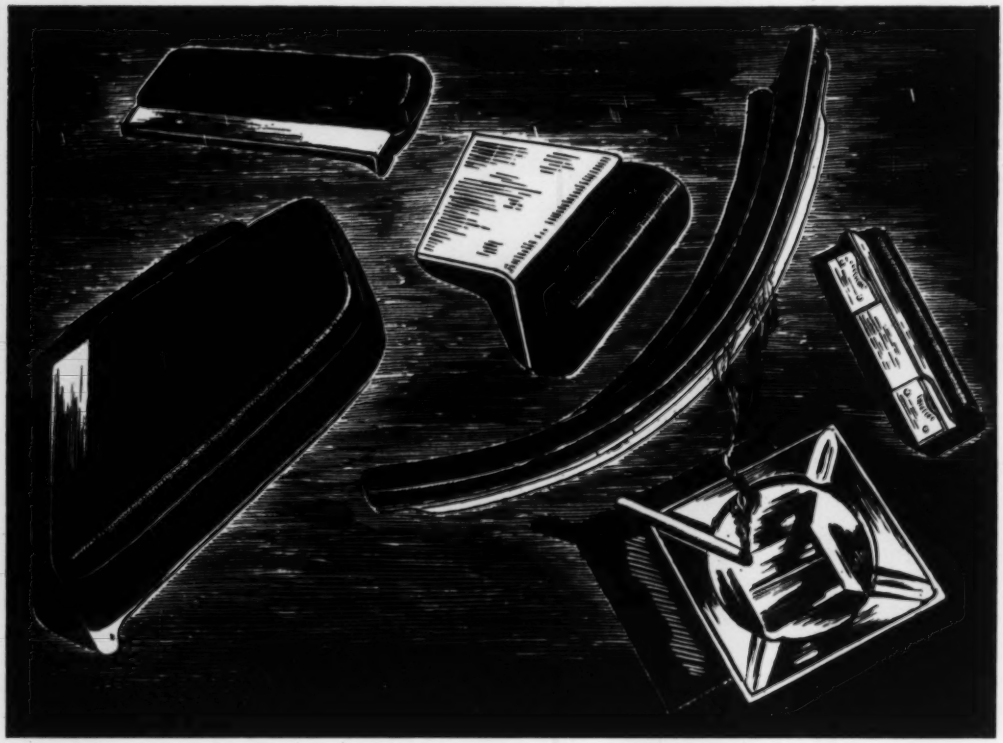
WALDES KOHINOOR, INC., LONG ISLAND CITY 1, NEW YORK

WALDES TRUARC RETAINING RINGS AND PLIERS ARE PROTECTED BY ONE OR MORE OF THE FOLLOWING U.S. PATENTS: 2,382,947; 2,382,948; 2,419,052; 2,420,921; 2,420,341; 2,439,765; 2,441,848; 2,455,103; 2,483,380; 2,483,383; 2,487,902; 2,487,903; 2,491,300; 2,509,091 AND OTHER PATENTS PENDING.

Waldes Kohinoor, Inc., 47-16 Austel Place, L. I. C. 1, N. Y.
Please send engineering specifications and data on Waldes Truarc Retaining Ring types checked below. ME-044

- ☐ Bulletin #5 Self-locking ring types
- ☐ Bulletin #6 Ring types for taking up end-play
- ☐ Bulletin #7 Ring types for radial assembly
- ☐ Bulletin #8 Basic type rings
- ☐ Send me information about the Waldes Grooving Tool.

Name_____
Title_____
Company_____
Business Address_____
City_____ Zone_____ State_____ 5678



CELLULAR RUBBER BONDED TO METAL

one more example of the versatility of SPONGEX

Each of these parts was made by bonding Spongex cellular rubber to metal. Yet in each, Spongex had to meet different specifications. In one, Spongex must remain flexible even at −65° F. In another, it must be heat resistant and fire retardant. A third must have low water absorption. *All* possess one important quality . . . the superior bonding characteristics of Spongex for unexcelled adhesion of rubber to metal.

Bonding of Spongex to metal might not be your need. But if your need is cellular rubber, we've got it . . . in strips, rolls, cording, tubing and die-cut shapes. Learn more about how Spongex can help you . . . write for "Properties of, and Test Data on, Cellular Rubber."

SPONGEX® Cellular Rubber

used for cushioning, insulating, shock absorption, sound and vibration damping, gasketing, sealing, weatherstripping and dust proofing.

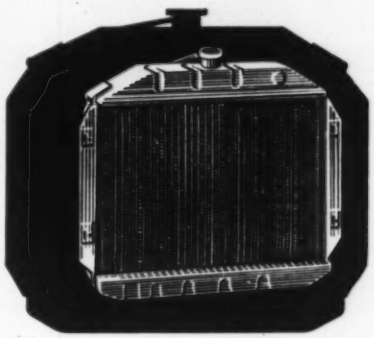
THE SPONGE RUBBER PRODUCTS COMPANY 501 Derby Place, Shelton, Conn.

BUSINESS IN MOTION

To our Colleagues in American Business . . .

Substitution of materials is of considerable concern to many manufacturers these days. Never before have we seen so much interest in the subject. However, it is by no means new to Revere, which has always held to the principle of recommending the metal that will best serve the customer. Thus, we have often suggested switching from one metal or alloy to another, with the object of lowering costs, increasing production, improving service, or all three.

When based on a detailed study of all the factors involved, substitution at times can be extremely valuable. In fact, the ever-increasing quality and service to be found in American products is due in part to the continued search for better materials, and their adoption when found. Better materials, better design, finer workmanship—these are part of American progress.



But there are instances, of course, when no practical substitute can be found, when only one material offers just the right combination of good qualities required for a given application. Take the automobile radiator. This has always been made of copper, because copper is the one and thus far only metal that perfectly meets all the requirements of manufacture and service. To make a radiator, very thin copper sheet and strip must be crimped, bent and otherwise formed. Copper's easy workability makes it ideal from the manufacturing standpoint. After assembly, the radiator is cleaned, and made water-tight by dipping in a bath of hot solder. Copper is exceptionally easy to solder. When in service on a car, truck or bus, the radiator must not rust, and must resist corrosion by water and anti-freeze. Copper is notable for its resistance to corrosion in such use. The radiator must also cool the water by radiating its heat into the air stream; copper has the highest heat conductivity of all commercial metals. A copper radiator thus is the most efficient and durable. It should outlast the car unless accidentally damaged, and when the injury is not so great as to make replacement necessary, the nearest shop can make repairs easily.

Recently it has been suggested that automotive radiators should be made of aluminum. However, both copper and aluminum are temporarily in short supply, and therefore to substitute one for the other does not appear to be practical. Beyond that, we do not believe —based upon experience to date—that aluminum's qualities, fine though they are, necessarily make it suitable for automotive radiators. In addition, the difficulties of retooling in the factory and repairs in the field must be considered. Revere fabricates both copper and aluminum, and we have reason to believe that our impartial advice to stay with copper for automotive radiators is concurred in by radiator manufacturers.

When you are tempted to substitute one material for another in your product, no matter what it may be, make certain you obtain all the facts as to costs, production, service. Your suppliers will be glad to collaborate with you in studying the effects of a proposed change. We suggest you take full advantage of their knowledge and experience.

REVERE COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

Executive Offices: 230 Park Avenue, New York 17, N.Y.

SEE "MEET THE PRESS" ON NBC TELEVISION EVERY SUNDAY

Straight-Flow Port Design reduces fluid turbulence to a practical minimum.

Seat Rings of end-seated type are screwed into the body.

Sure-Grip Malleable Handwheel for non-skid gripping even with heavy gloves.

Brass Liner on Glands assures greater resistance to corrosion and scoring.

WALWORTH

iron body gate valves

with screwed or flanged ends

... 8 Outstanding Features

For complete information on these new Walworth Iron Body Valves, see your local Walworth distributor, or write for bulletin 106.

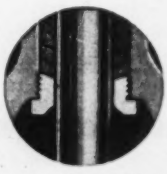
WALWORTH

valves and fittings

60 EAST 42nd STREET NEW YORK 17, N. Y.

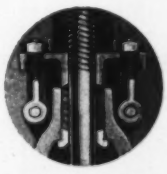
DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

T-head Disc-to-Stem connection on OS&Y types provides stronger connection, prevents loosening of disc by corrosion.

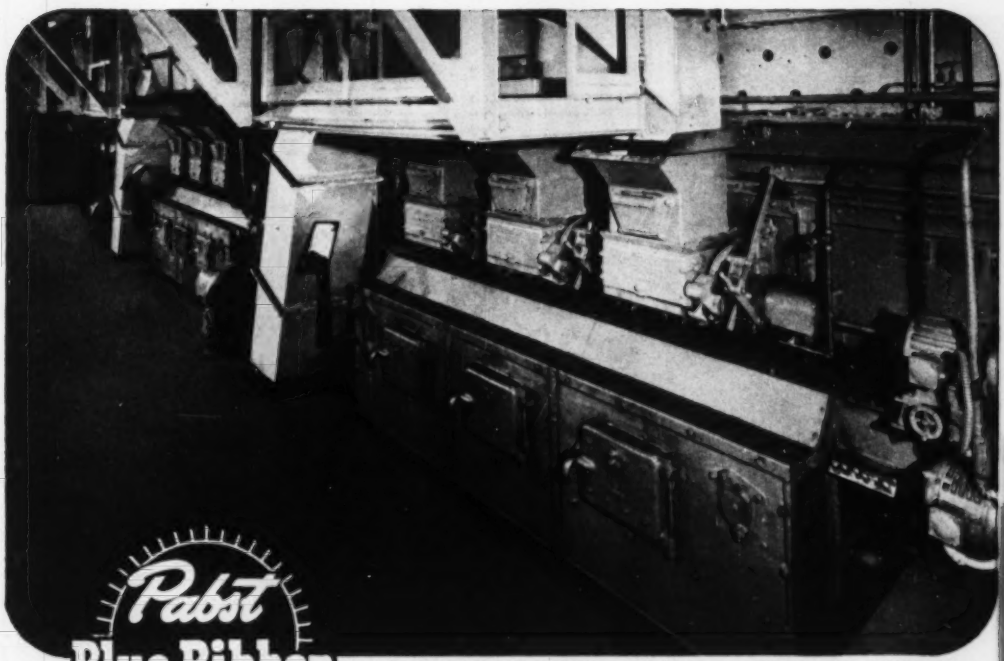


Bronze Back-Seat Bushings in bonnets of OS&Y valves.

Solid Web Type Disc in OS&Y valves for greater strength and longer service.



Hinged Gland Eye-Bolts on OS&Y valves permit faster, easier repacking under full pressure.



See Detroit RotoGrate Stokers in Pabst Brewing Company's new Milwaukee Boiler Plant. • Stone & Webster Engineering Corporation, Engineers.

Trademark Reg.
U.S. Pat. Off.

Pabst Blue Ribbon "HAS" DETROIT ROTOGRATE STOKERS

"What'll you have?" . . . "Pabst Blue Ribbon!" is a well known slogan. They "have" Detroit RotoGrate Stokers in their new Milwaukee plant, selected for their efficiency and dependability.

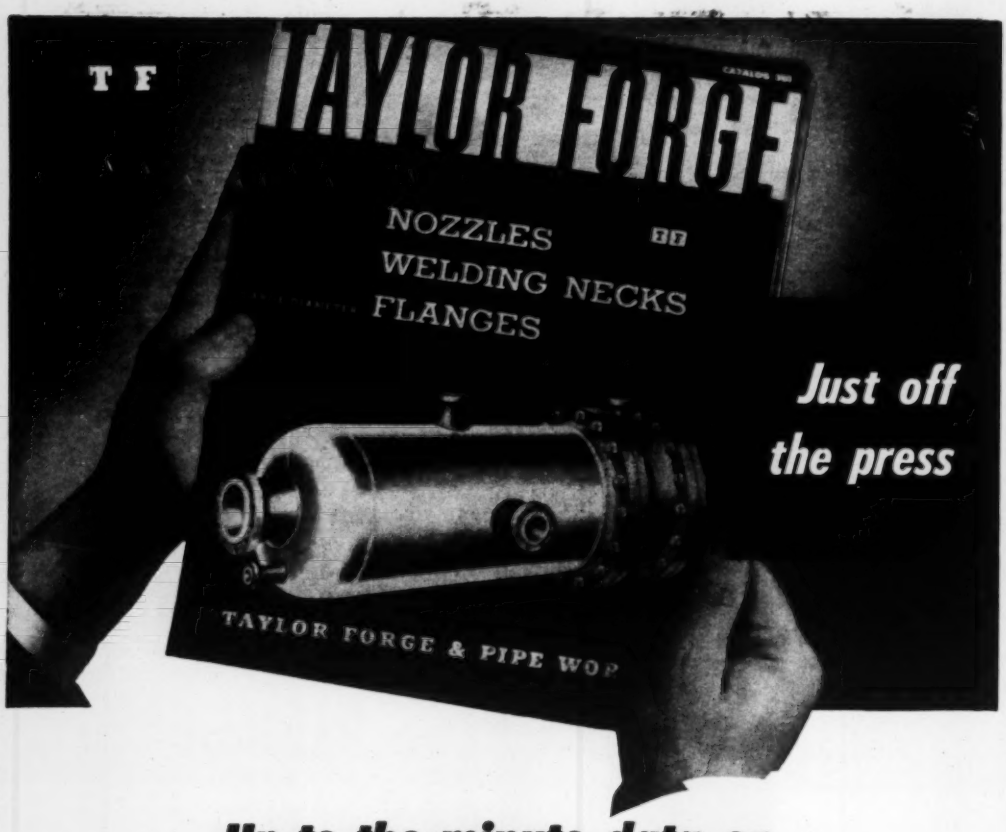
The RotoGrate is an advanced spreader stoker with forward moving grates that discharge the ash continuously at the front. The RotoGrate burns any type of Bituminous coal or Lignite and handles fluctuating loads without loss of pressure. All the steam you want when you want it, because of high burning rates that are possible. 4473

INVESTIGATE THE DETROIT ROTOGRATE STOKER

DETROIT STOKER COMPANY

General Motors Building—Detroit 2, Michigan

District Offices in Principal Cities • Works at Monroe, Michigan



Up-to-the-minute data on pressure vessel outlets

IN THIS new Pressure Vessel Catalog 501 you will find the latest data covering pressure vessel outlets compiled as you would expect it to be by the originators of forged and rolled steel welding necks and nozzles.

The pages include up-to-the-minute information on seamless steel nozzles, welding necks, manways, and large diameter flanges for boilers, heat exchangers, and other pressure vessels. Of particularly timely importance are data covering standards of Tubular Exchangers Manufacturers Association (TEMA Standards). A useful section on modern flange design covers codes, materials, and design procedures with typical calculation forms and examples of calculation.

This 118 page book is available without charge to anyone having a specific interest in outlets for pressure vessels. To obtain your copy see your Taylor Forge Distributor or **MAIL THE COUPON.**

TAYLOR FORGE

TAYLOR FORGE & PIPE WORKS

General Offices and Works: P. O. Box 485, Chicago 90, Ill.

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Send me a copy of your Pressure Vessel Catalog No. 501

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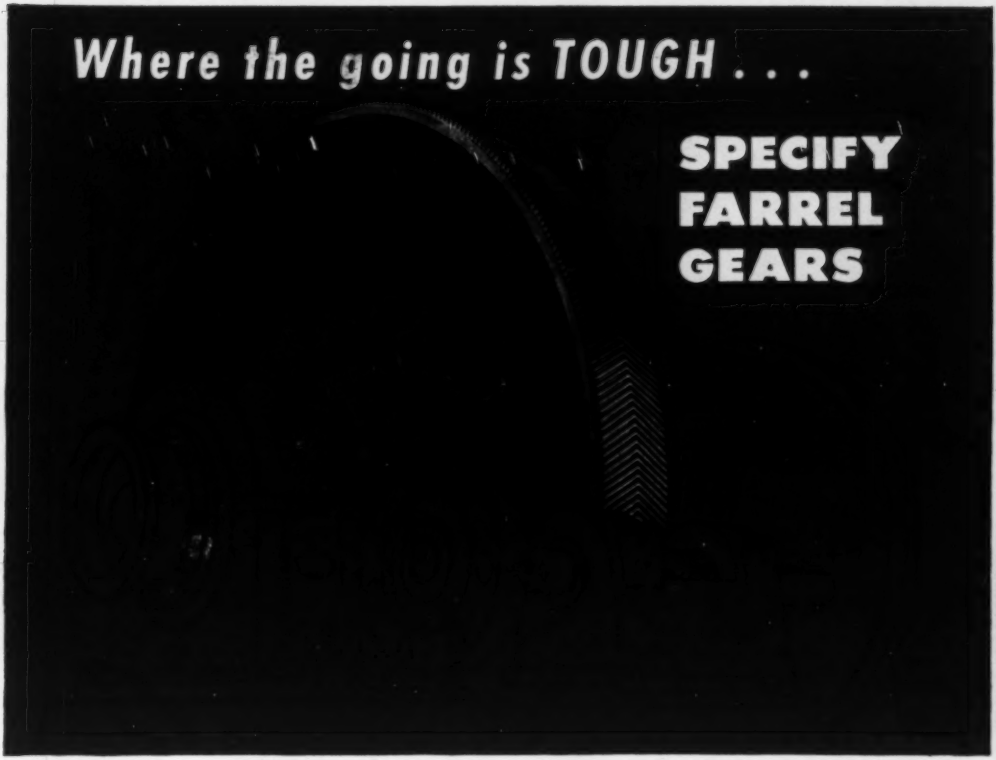
504-5452. Mail to Taylor Forge & Pipe Works, P. O. Box 485, Chicago 90, Ill.

Where the going is TOUGH . . .



SPECIFY FARREL GEARS

Precision generation combined with the use of highest grade materials gives Farrel herringbone gears the ability to withstand the heaviest shock loads encountered in machine applications.

Accuracy of tooth contour and tooth spacing, overlap or interlacing of the teeth, gradual engagement and inclined line of pressure contribute to smooth operation and maintenance of correct tooth action throughout a long gear life. The opposed helices balance and absorb axial thrust within the gear member, preventing harmful thrust loads with resultant stresses on other parts of the machinery.

Farrel engineers are available to assist in working out unusual gear problems. Information about herringbone gears, or any of the other types mentioned on this page, will be sent on request.

FARREL-BIRMINGHAM COMPANY, INC., ANSONIA, CONN.

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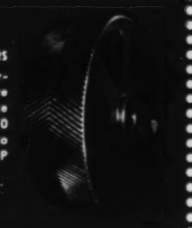
Farrel-Birmingham®

FB-734

HERRINGBONE GEARS

Farrel-Sykes herringbone gears are available in any size from ¼ inch to 20 feet diameter, ¼ to 60 inch face, 24 DP to 0.75 DP.



STRAIGHT TOOTH AND SINGLE HELICAL GEARS

Farrel also supplies straight tooth (spur) gears and single helical gears in any size from ¼ inch to 20 feet diameter, ¼ to 30 inch face, 24 DP to 0.5 DP.

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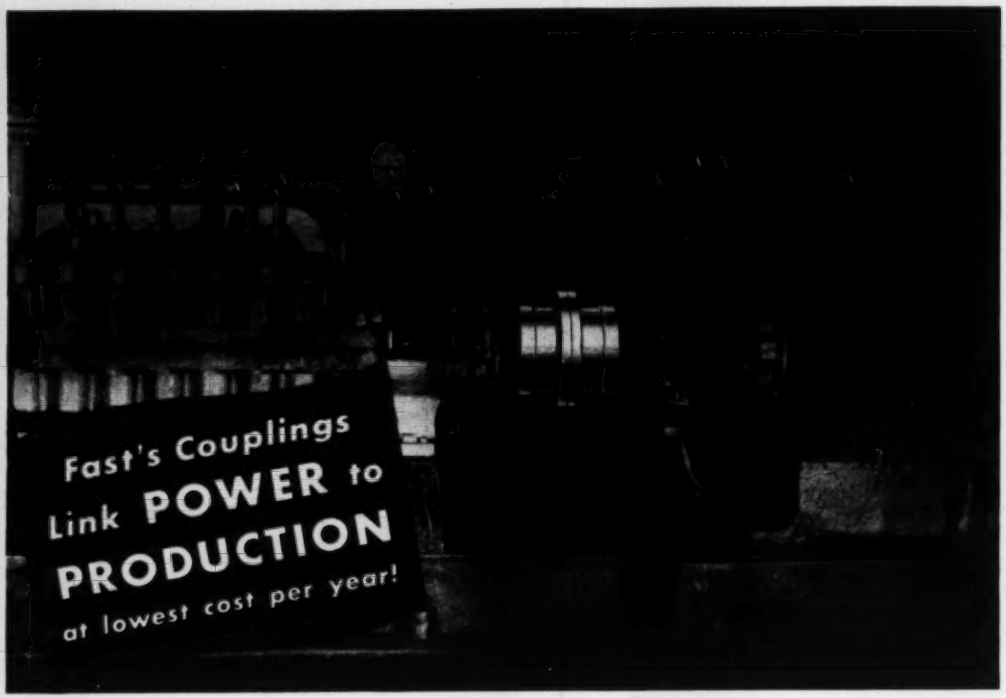
Large internal gears are available with either spur or helical teeth, in sizes up to 18 feet diameter, 12 inch face, 1¼ DP.



Over half a million FAST'S Couplings now in use!

THROUGHOUT industry, Fast's are rated the most dependable couplings on the market... to the tune of over half a million now in service! Year in, year out, they continue to *outlast the equipment they connect* . . . save time, maintenance and money by eliminating costly coupling failures.

Actual cases on record show many Fast's Couplings have been in operation for 25 and 30 years without trouble. And every major producer of high-speed equipment now uses Fast's!

Solve your coupling worries! Write today for full details on Fast's Couplings and Koppers Engineering Service to: KOPPERS COMPANY, INC., *Fast's Coupling Dept.*, 254 Scott St., Baltimore 3, Maryland.

Here's How FAST'S Save You Money

Free Service—Koppers free engineering service assures you the right coupling for the job.

Rugged Construction—Fast's still maintains its original design, without basic change or sacrifice in size or materials. Result: freedom from expensive coupling failures.

Lowest Cost per Year—Fast's Couplings usually outlast equipment they connect. Their cost may be spread over many years!

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FAST'S
THE ORIGINAL
GEAR-TYPE
Couplings

INDUSTRY'S STANDARD FOR 32 YEARS

KOPPERS COMPANY, INC., *Fast's Coupling Dept.*
254 Scott St., Baltimore 3, Md.

Gentlemen: Send me Fast's Catalog which gives detailed descriptions, engineering drawings, capacity tables and photographs.

Name .....

Company .....

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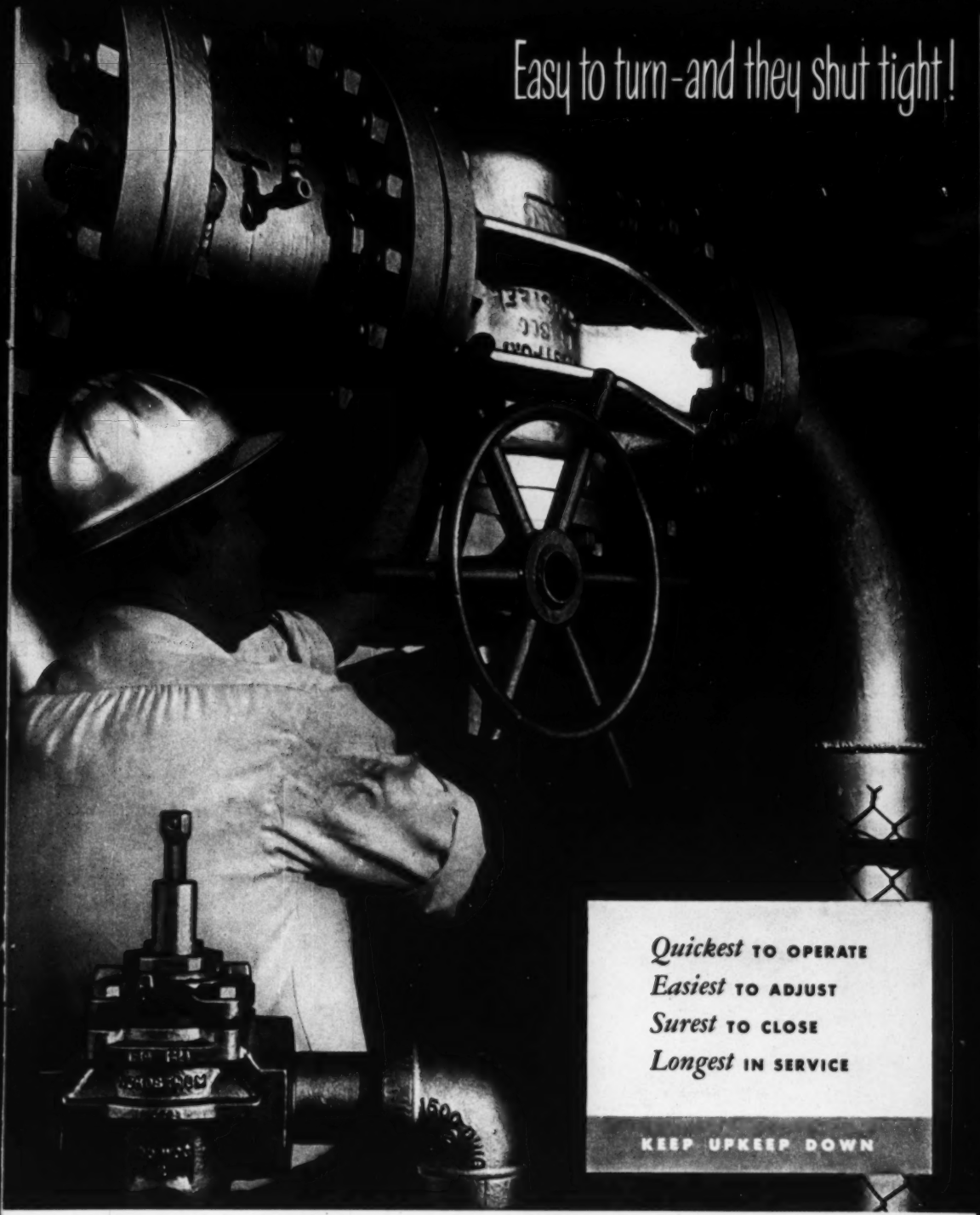
City ..... *Zone* ..... *State* .....



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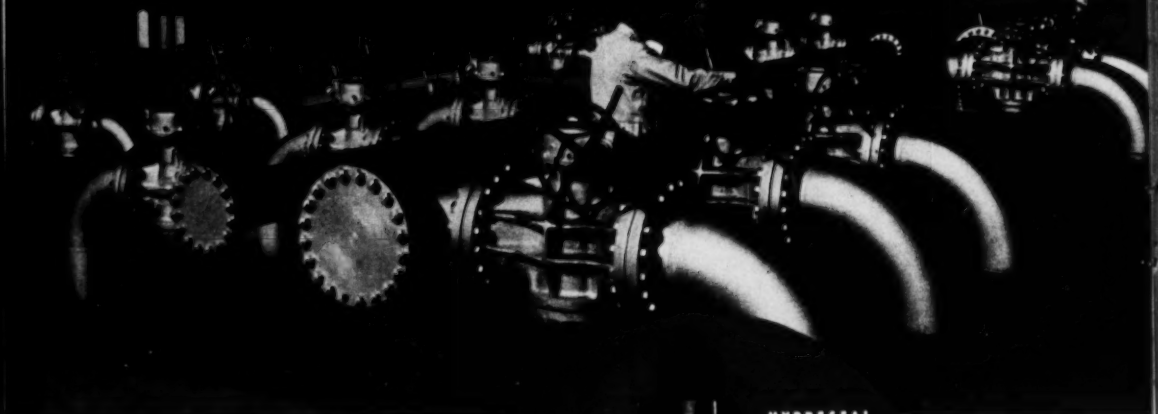
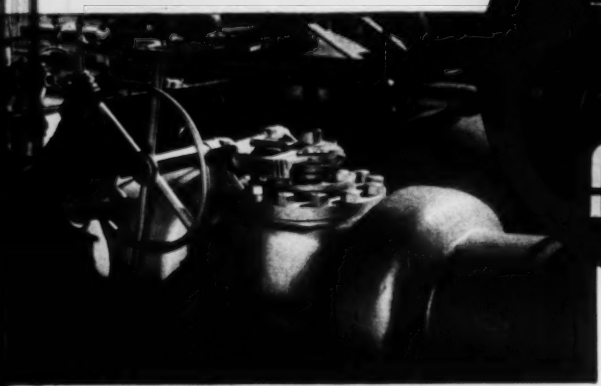
...NOW AUTOMATICALLY LUBRICATED WITH Trade Mark Hypermatic Pats. Applied for

NORDSTROMS *hold the line!*



OIL PIPE LINE TERMINAL



HYPRESEAL

INSULATED—HOT OR COLD

OIL FIELD MANIFOLD

COOLING TOWER HEADERS

Nordstrom

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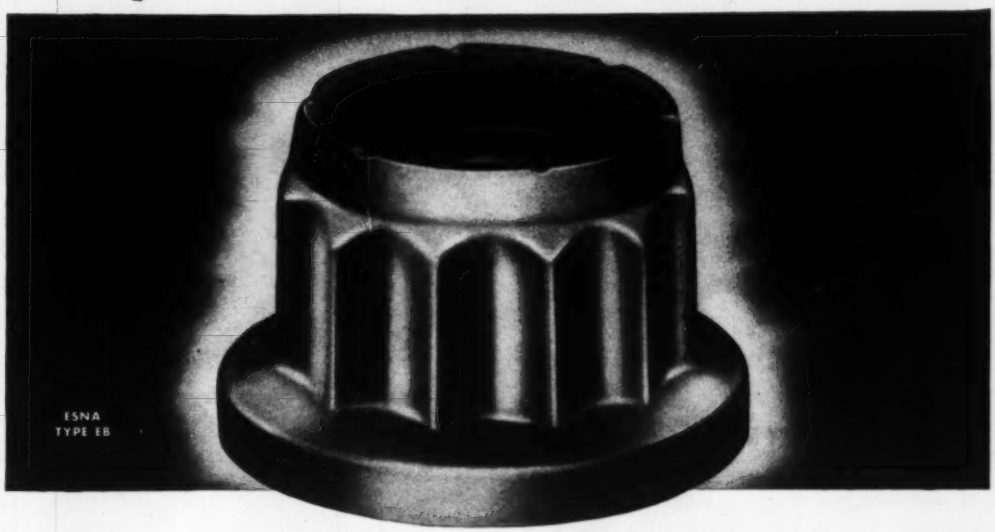
ROCKWELL MANUFACTURING COMPANY

400 North Lexington Avenue, Pittsburgh 8, Pa.

Atlanta, Boston, Chicago, Columbus, Houston, Kansas City, Los Angeles, New York, Pittsburgh, San Francisco, Seattle, Tulsa . . . and leading Supply Houses. Export: International Division, Rockwell Manufacturing Company, 7701 Empire State Building, New York 1, N. Y.

High Strength DOUBLE HEX NUT CUTS SIZE...WEIGHT OF AIRFRAME COMPONENTS



—the famous Self-Locking Red Elastic Collar

***protects permanently against* IMPACT! VIBRATION!**

The NEW ESNA HIGH Strength-Double Hex Nuts have been scientifically engineered to accomplish distribution of thread load with minimum weight and wrench diameter. They develop 185,000 psi. min. in NAS high strength aircraft bolts, and are completely interchangeable with existing internal wrenching nuts; yet this unique double hex design saves 66% in weight and 50% in height, compared to the old internal wrenching types. These savings in weight and clearance gain greater importance when multiplied by the additional savings in the size and weight of component parts or fittings which the new design makes possible to employ.

Because of their light weight . . . extra safety . . . easy field identification . . . and reduced wrenching area, ESNA Type EB Nuts are accepted as standard for all high tensile applications by airframe manufacturers. Also, of great importance maintenance-wise is the fact that no special wrenches are required—any socket wrench will do.

Further—like all Elastic Stop Nuts—the NEW High Strength Nut remains self-locking in both fully seated and positioned settings.

HERE'S A CHALLENGE: Send us complete details of your toughest bolted trouble spot. We'll supply test nuts—FREE, in experimental quantities. Or, if you want further information, write for literature. Elastic Stop Nut Corporation of America, Dept. N4-411 Union, New Jersey. Representatives and Agents are located in many principal cities.

ESNA

ELASTIC STOP NUTS

HIGH TENSILE · ANCHOR · HIGH TEMPERATURE · SPLINE · CLINCH · GANG CHANNEL · NYLON CAP

NYLON AND FIBER INSERT TYPES ARE QUALIFIED TO SPEC. AN-N-5

BIGGEST NEWS IN '52...

"A SIZE FOR EVERY NEED"

HYDRAULICALLY BALANCED DESIGN — Reduces wear, improves operation, prolongs life of unit.

FOUR SIZES — Plus interchangeable cam rings for a variety of pump or motor capacities.

CONVERTIBLE — Ready for either pump or motor applications without alterations of any kind.

NEW HIGHLY COMPACT DESIGN — Rugged heavy-duty construction gives the Pump/Motor plenty of stamina for long, hard, continuous duty at 2000 psi. Only three major components.

INTERCHANGEABLE CAM RINGS — Range of capacities as pump or motor thru interchangeable cam rings.

BI-DIRECTIONAL ROTATION — Adjustable for either clockwise or counter-clockwise operation.

WIDEST ADAPTABILITY — Porting location and direction of rotation adjustable to eight different combinations.

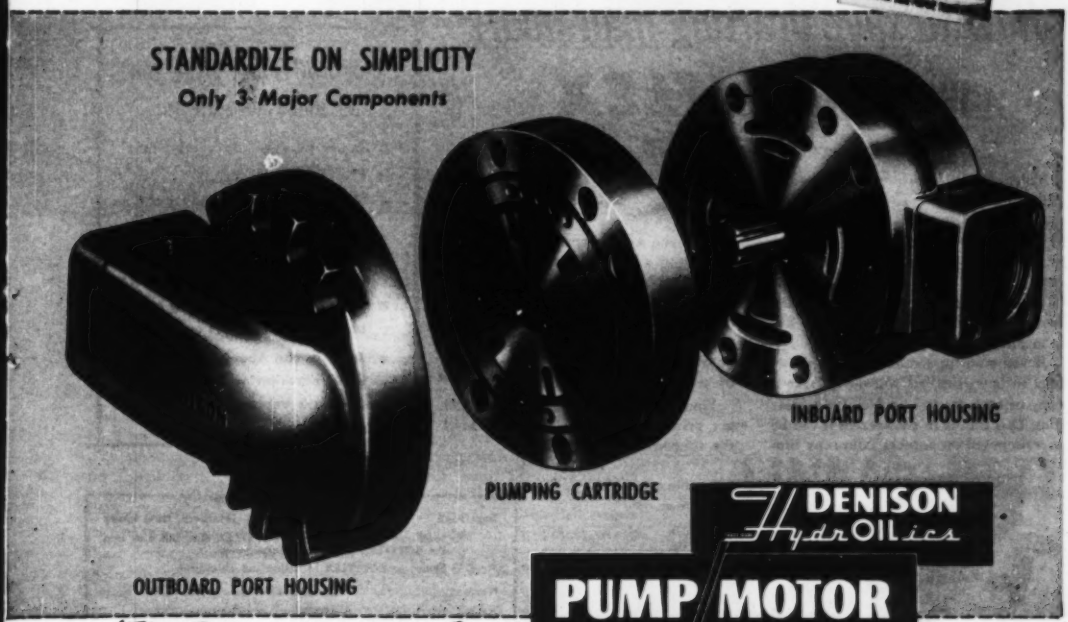
THE DENISON ENGINEERING COMPANY, 1189 Dublin Road, Columbus 16, Ohio

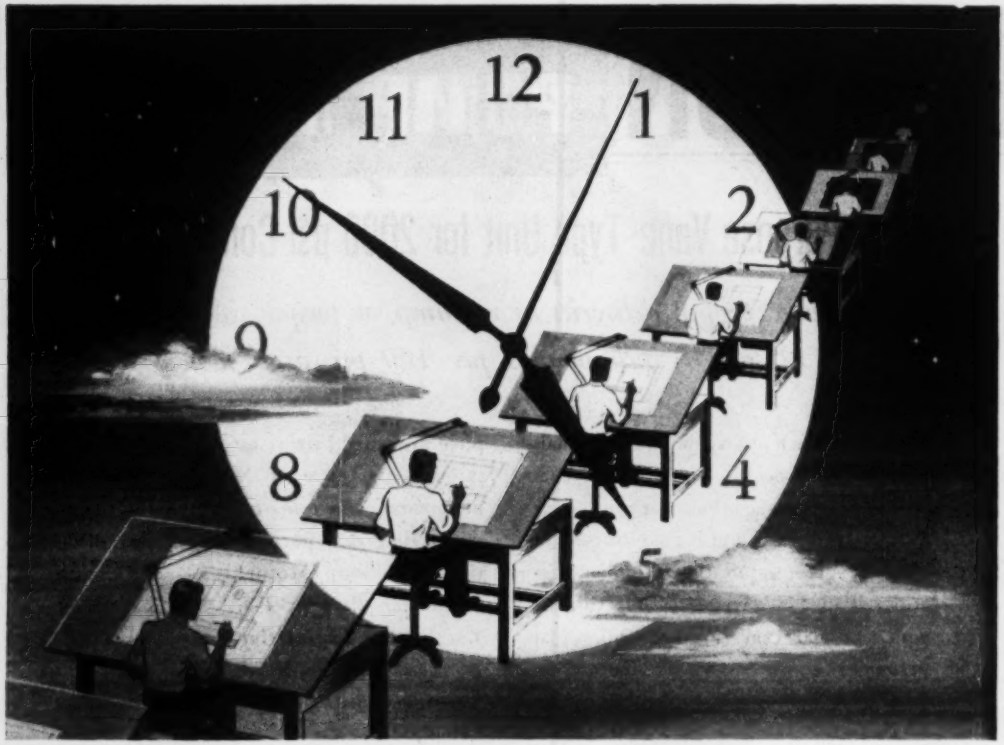
..DENISON PUMP/MOTOR

New Dual-Purpose Vane-Type Unit for 2000 psi Continuous Duty

2½ to 70 gpm deliveries as a pump, or torque ratings of 12 to 257 inch-pounds per 100 psi, as a motor

Denison scores a new achievement in dual-purpose pump design. This all-new, vane-type power package is built for *continuous duty* at 2000 psi — and is ready for either pump or motor applications without alterations of any kind! Four sizes are available, with optional cam ring assemblies that permit eleven models, for different pump-volume or motor-torque capacities. Complete hydraulic balance assures longer life through reduced wear. New single stage design and many other features add to the outstanding dual-purpose adaptability of this new Pump/Motor! *Write for Bulletin P-5. The Denison Engineering Co., 1189 Dublin Road, Columbus 16, Ohio.*





How to save drafting man-hours with COPYFLEX

NO. 138 FILM

You can save redrawing time and get prints faster by using the Bruning COPYFLEX process and its No. 138 film.

If you want to change a drawing yet keep the original intact, just make a copy on No. 138 Matte film, make your changes on this copy (the fine-tooth surface is excellent for drawing), then use it to make all the prints you need.

If you want to combine several drawings in one print, all you do is make a copy of each tracing on No. 138A clear film. This film is so transparent it can be superimposed on another COPYFLEX film or cloth or tracing and printed . . . resulting in a sharp print that *combines* the images.

Or if you want to speed production of prints from a faded original, simply make a copy on No. 138D clear film and get denser lines on a more transparent stock that will print better and faster.

For all these time-savers you need COPYFLEX . . . with its unexcelled range of sensitized papers, cloths and film.

Find out how you save man-hours and get prints faster with COPYFLEX. Mail the coupon for full details.

Only *COPYFLEX* gives you all these advantages!

- Top-quality prints ready for immediate use
- No installation — simply make an electrical connection
- No fumes or exhausts because it uses no vapor developer
- Wider range of sensitized and coated papers, cloths and films
- Anyone can operate a COPYFLEX machine with a simple 5-minute explanation

COPYFLEX "93" is virtually automatic, handles cut sheets or roll stock up to 42 in. wide.

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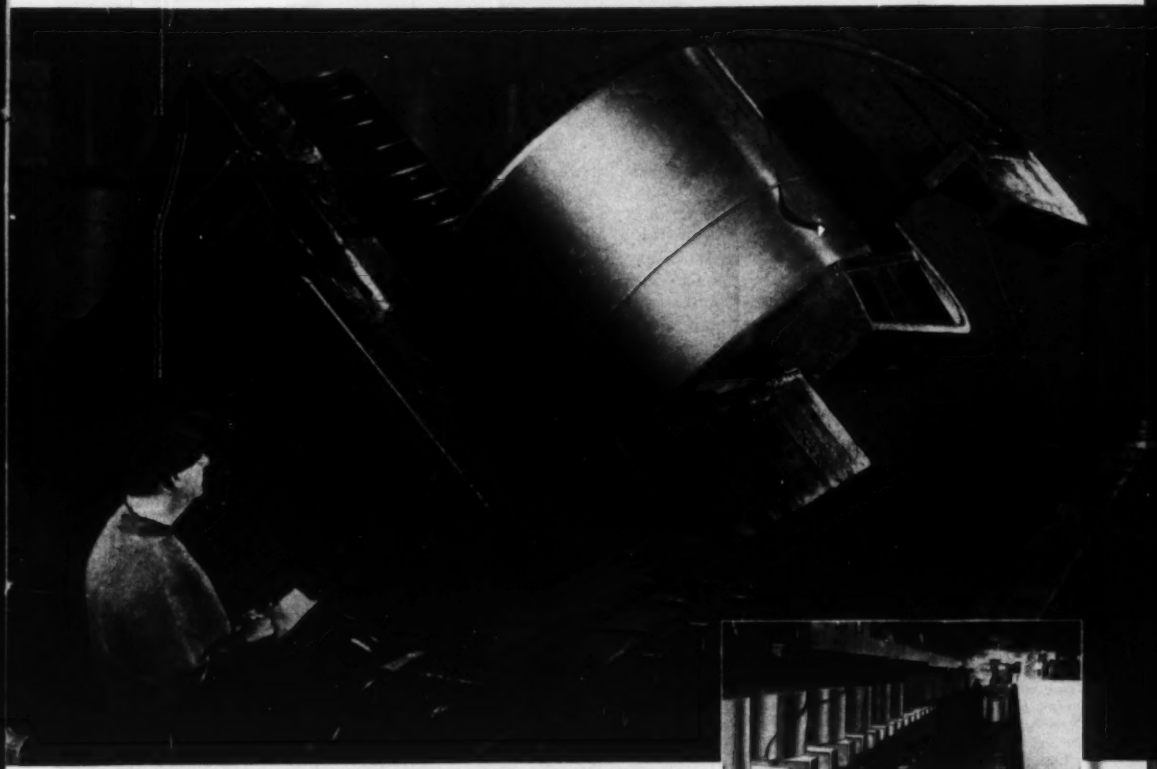
LINK-BELT Research and Engineering . . . Working for Industry

It "babies" giant steel coils to boost yield...cut waste



Link-Belt down-tilter (main photo) lifts coils from double-strand roller chain conveyor, turning them 90° onto troughed gravity rolls. Inset shows Link-Belt car-type coil conveyor.

LINK-BELT conveyors economically move up to 38-ton coils with no scuffing, no telescoping

The facility to handle large coils of steel strip efficiently is responsible for much of America's ever-increasing rate of steel production. Specialized conveying systems—designed, built and installed by Link-Belt—play an important part in this continuing progress.

Coils weighing up to 76,000 pounds can now be moved around corners, up and down inclines. Auxiliary devices transfer the coils from one conveyor to another . . . turn, weigh, lower or tilt them—with improved safety and a minimum amount of manual control—to match the high capacity of modern new mills.

Yet so gently is this done that there's no scuffing of edges, no telescoping of coils. Yield is increased because of lower scrap losses.

Helping steel mills boost output and lick waste in handling coils, plates, rods, billets and bulk materials is typical of Link-Belt research and engineering. In almost any industry you can name, Link-Belt products are showing the way to lower costs in processing, materials handling and power transmission applications.

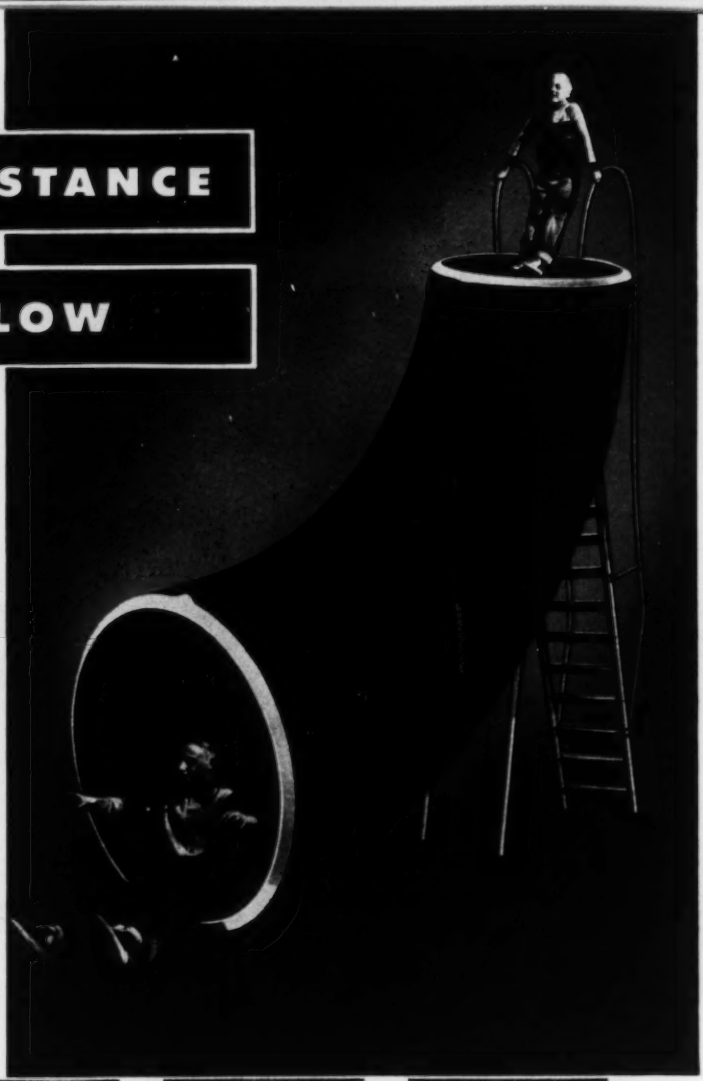
LINK-BELT

LINK-BELT COMPANY

Executive Offices:
307 N. Michigan Ave., Chicago 1, Ill.
Plants: Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Houston 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8, Springs (South Africa), Sydney (Australia). Offices in Principal Cities.
12,700

ONE SOURCE . . . ONE RESPONSIBILITY FOR MATERIALS HANDLING AND POWER TRANSMISSION MACHINERY

LOW RESISTANCE to FLOW



Minimum resistance to flow . . . that is the feature of Midwest Welding Fittings we call to your attention with this photographic fantasy. Other superior qualities that result from our unique manufacturing methods are dimensional accuracy and uniformity . . . true circular cross-section, controlled wall thickness, and accurate radius, included arc and tangents. The consequent benefits are a saving in welding time and a better piping system.

4581

MIDWEST "LONG TANGENT"

Same radius as ASA but tangent equal to 25% of nominal pipe size on each end. Saves pipe, layout and welding time. Costs no more than ASA. Sizes to 24".

ASA STANDARD

Dimensions conform to applicable size range of American Standard for Butt-Welding Fittings, ASA B16.9. Tolerances much less than allowable. Sizes to 26".

SHORT RADIUS

Recommended where space limitations do not permit use of "Long Tangent" or ASA Elbows. Sizes to 30".

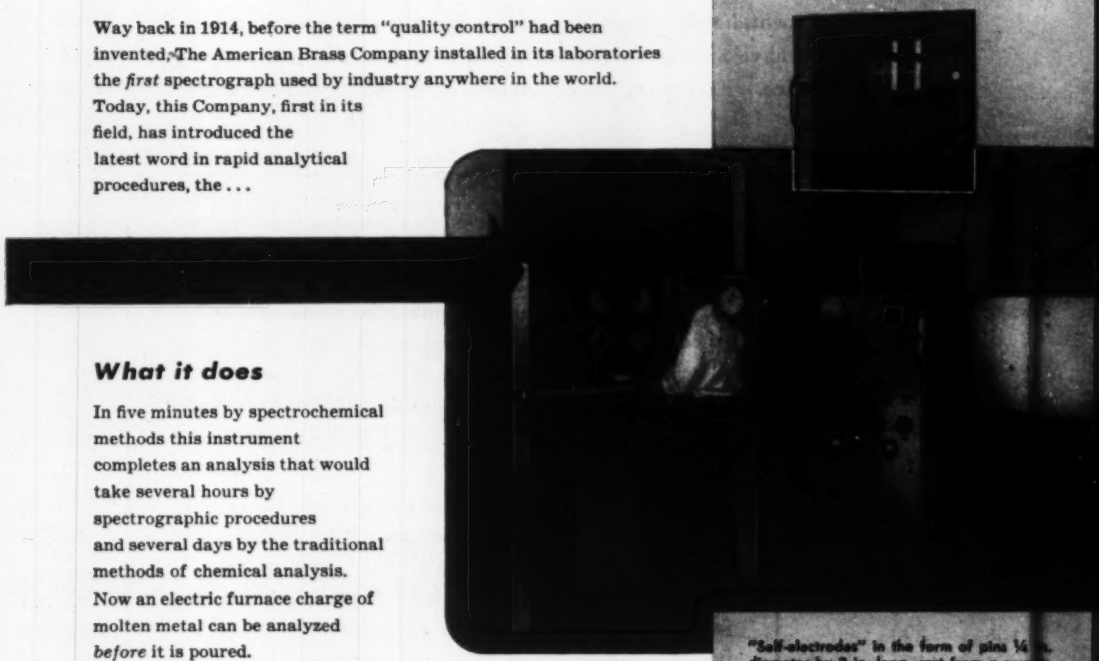
MIDWEST REDUCING

Takes the place of a straight size elbow and a reducer. Eliminates one weld, reduces pressure drop, easier to insulate. Sizes to 12", reductions to half size.

LEADERSHIP can't stand still

this time it advances on spectral waves

Way back in 1914, before the term "quality control" had been invented, The American Brass Company installed in its laboratories the *first* spectrograph used by industry anywhere in the world. Today, this Company, first in its field, has introduced the latest word in rapid analytical procedures, the . . .



What it does

In five minutes by spectrochemical methods this instrument completes an analysis that would take several hours by spectrographic procedures and several days by the traditional methods of chemical analysis. Now an electric furnace charge of molten metal can be analyzed *before* it is poured.

"Self-electrodes" in the form of pins ¼ in. diameter by 2 in. long, cast from a sample of the melt to be analyzed, are accurately spaced in the electrode holders of the Baird Associates—DOW Direct Reading Spectrometer (top illustration). A button is pressed—and a 25,000-volt spark bridges the gap. Then . . .

Light from the spark falls on a grating and is reflected, in a separate spectrum line for each element, onto photomultiplier tubes. Seconds later, accurate, direct dial readings indicate the amount of alloying elements present and the amount of impurities, such as iron, nickel, manganese, aluminum, silicon, lead, arsenic, phosphorus and antimony.

With the analysis of the melt known to be right, a "go-ahead" is flashed to the casting shop and the metal is poured.

What it means

This continuing leadership in the application of scientific developments to production has many practical advantages. For instance: In conserving copper and zinc by making maximum use of scrap in such an important alloy as cartridge brass. The rapid, complete analysis for metal content and impurities permits a high degree of control not otherwise possible. Thus, through the development of spectrochemical analysis you are assured of new high standards of uniformity in Anaconda Metals—unsurpassed by *any* in the industry. The American Brass Company, General Offices, Waterbury 20, Connecticut. 8207

ANACONDA

sets the pace in quality control of

COPPER and COPPER ALLOYS

TO THE MEMBERS OF———

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

Members of the ASME are invited to name any number of engineers as candidates for membership. Engineering acquaintances should be qualified by both fundamental training and experience for one of the technical grades. Those who do not have an engineering degree may show the equivalent thereof through actual practice. Executives of attainment in science or industry may affiliate as Associates.

THE American Society of Mechanical Engineers promotes Mechanical Engineering and the allied arts and sciences, encourages original research, fosters engineering education, advances the standards of engineering, promotes the intercourse of engineers among themselves and with allied technologists; separately and in cooperation with other engineering and technical societies, and works to broaden the usefulness of the engineering profession.

As a post graduate school of engineering, the Society brings engineers into contact with each other, with leaders of thought and with new developments; it fosters the interchange of ideas, develops professional fellowships, and encourages a high standard of professional conduct—all with the purpose of advancing civilization and increasing the well-being of mankind.

C. E. Davies, Secretary
The American Society of Mechanical Engineers
29 West 39th Street, New York 18, N. Y.

Date.....

Please send an application and information regarding ASME to the following:

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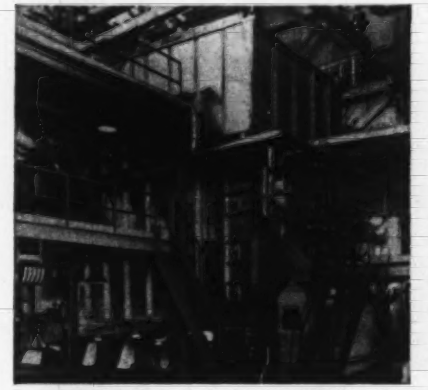
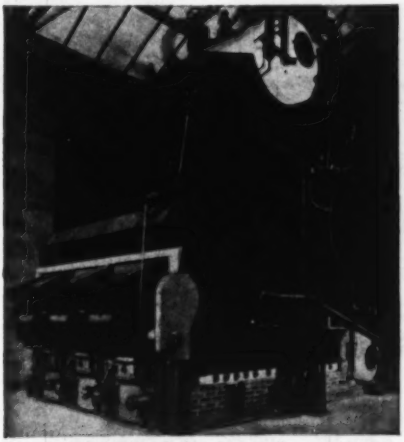
ME-4-52

The VU Story for 1951



Typical Vertical-Unit Boiler for larger industrial or utility plants. Capacities range up to 350,000 lb steam per hr. May be fired with pulverized fuel, oil, gas or any type of stoker. Pressures up to 1000 psi; steam temperatures to about 900F.



Typical Vertical-Unit Boiler for smaller applications. Available in capacities from 10,000 to 60,000 lb steam per hr. Suitable for firing with any type of stoker or oil or gas.

When you buy a boiler the manufacturer's long experience is a very important consideration, and Combustion has that. But even more significant is *current* experience . . . experience in meeting steam requirements similar to yours. And Combustion has that, too.

Here is a comprehensive picture of contracts placed for C-E Vertical-Unit Boilers during 1951.

STEAMING CONDITIONS – Capacities ranging from 11,000 to 300,000 pounds of steam per hour . . . design pressures from 160 to 975 pounds per square inch . . . steam temperatures from 420° to 900° F.

FUELS AND FIRING – Bituminous coal as supplied from all principal mining areas; also anthracite, lignite, oil, gas, bagasse, bark, wood and various refuse fuels. All present-day methods of firing and types of firing equipment are represented including combination firing of two or more fuels.

GEOGRAPHICAL – Units ordered during 1951 will be installed in 27 states, in seven Latin American countries and in Africa, Arabia, Australia, Canada, Israel and Spain.

INDUSTRIES – Automobile, Brewing, Building Materials, Cement, Chemical, Food Products, Government, Institutions, Lumber, Machinery, Metal Mfg., Mining, Paper, Petroleum, Public Utilities, Railroads, Rayon, Rubber, Shipbuilding, Soap, Sugar and miscellaneous manufacturing.

What this adds up to is that VU Boilers have nationwide and worldwide acceptance . . . that 1951 contracts represent a full range of capacities, pressures and temperatures and virtually every fuel and method of firing.

So you can select a C-E Vertical Unit Boiler with complete assurance that your installation will not only reflect Combustion's long experience – more than 20 years – with the basic VU design but will also reflect C-E's comprehensive *current* experience in applying this design for conditions identical to yours.

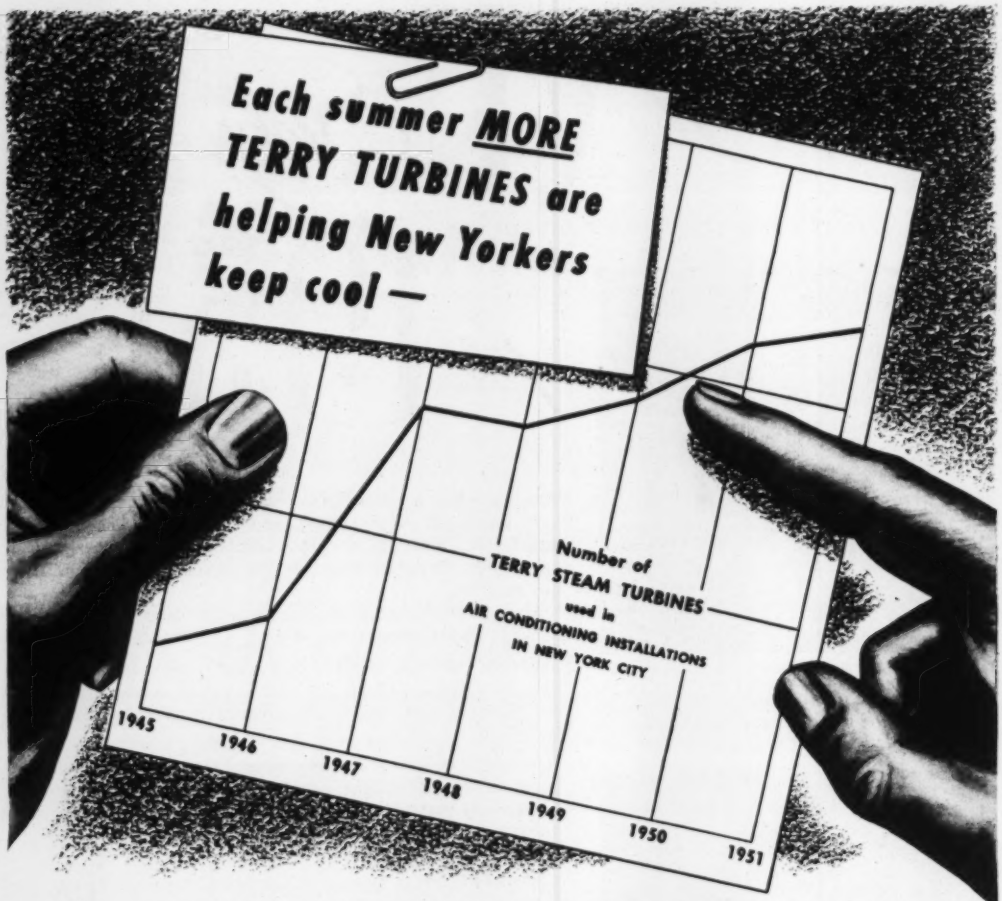
B-559A

C-E

COMBUSTION ENGINEERING — SUPERHEATER, INC.

200 Madison Avenue, New York 16, N. Y.

ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS



In recent years, New York City has witnessed a rapid gain in the number of air-conditioning installations providing comfort cooling by means of steam. And, as the accompanying chart shows, TERRY STEAM TURBINES have figured prominently in this relatively recent development.

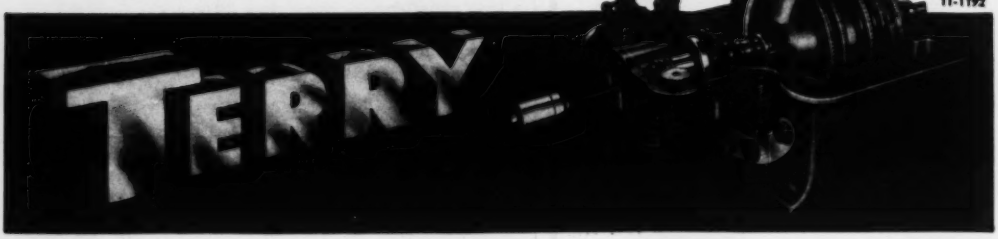
TERRY TURBINES make an ideal prime mover for driving the refrigerating compressor. They respond automatically to the temperature requirements, and will cut back to as little as 15 percent of rating without attention. A Terry-designed unit assures economy and ease of operation.

Before you make a decision on your air-conditioning installation, why not call in a Terry representative? He will be glad to explain the benefits of *comfort cooling by steam.*

PARTIAL LIST OF TERRY TURBINE INSTALLATIONS IN NEW YORK CITY
Best & Co. • Bloomingdale Bros. • Book-of-the-Month Club Carbide & Carbon Building • Federal Reserve Bank • Lord & Taylor • Macy's New York • Madison Square Garden James McCreery & Co. • Mutual Life Insurance • Port Authority Bus Terminal • The 260 Madison Avenue Building

THE TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.

TT-1192



Simplest Flow Measurement

with the ALL-METAL Foxboro d/p Cell!

. . . gives fastest response, longest sustained accuracy, lowest installation cost

Simpler in design, simpler and much less expensive to install, far easier to maintain . . . the all-metal Foxboro mercury-less *d/p Cell* offers greater speed of response, permitting closer flow *control*, than has ever been possible before. Its negligible displacement and corrosion-proof construction of Stainless Steel eliminate usual maintenance problems, even in service on highly corrosive or viscous fluids previously considered unmeasurable.

The Foxboro d/p Cell measures differential pressure by the force-balance principal and transmits pneumatically to indicating, recording, or controlling receivers. Small, compact, weighs as little as 19 lb. Ranges: from 25" to 800" H_2O. Working pressure ratings up to 4000 psi. Steel or stainless steel construction. Inherent over-range protection. Easy in-the-field calibration and range changes. Optionally available with pre-assembled manifold piping shown in photo above.

Thousands of d/p Cells now in use throughout industry, with many repeat orders now on our books, indicate the wide acceptance and successful performance of this revolutionary development for the measurement of liquid, steam, gas, or air flow. Write for detailed Bulletin 420. **The Foxboro Company, 1824 Neponset Avenue, Foxboro, Massachusetts, U. S. A.**

- No seal pots
- No mercury
- No leveling
- Installed at the orifice

RECORDING · CONTROLLING · INDICATING

INSTRUMENTS

FACTORIES IN THE UNITED STATES, CANADA, AND ENGLAND

NOTES for the Power Engineer

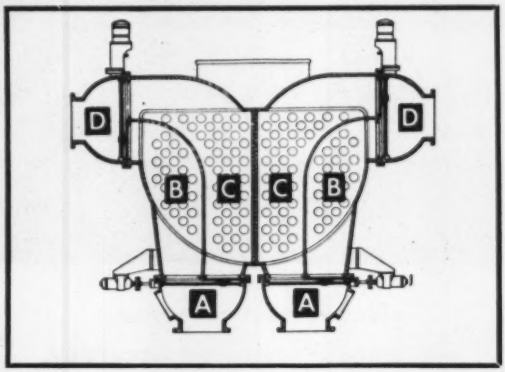
C. H. Wheeler OF PHILADELPHIA

STEAM CONDENSERS—STEAM JET EJECTORS—COOLING TOWERS—VACUUM REFRIGERATION—HIGH VACUUM PROCESS EQUIPMENT—MICRO-PARTICLE REDUCTION MILLS—MARINE CONDENSERS & EJECTORS—DECK MACHINERY

"REVERSE FLOW" CONDENSERS

SOLVE YOUR CLEANING PROBLEMS—REDUCE OPERATING COSTS

These advantages are possible only in C. H. Wheeler's unique design of an integral reverse-flow steam condenser. By an arrangement of electrically or hydraulically controlled sluice gates, the flow of water through the condenser tubes is reversed. Refuse is rapidly and thoroughly flushed down the discharge in a matter of minutes, without shutdown of the unit. In addition to saving cleaning time and eliminating labor costs, you improve the efficiency of the whole unit by not reducing load. The need for expensive mechanical water straining apparatus is also eliminated. Reverse-Flow may be incorporated in either divided or non-divided water boxes.



CROSS-SECTION DUAL BANK CONDENSER SHOWING HOW "REVERSE FLOW" WORKS

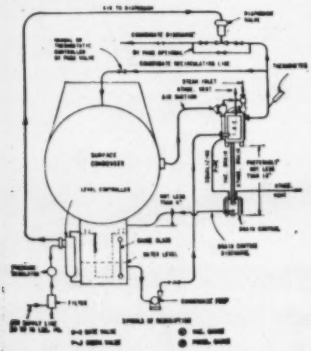
Both halves work the same but independently of each other.

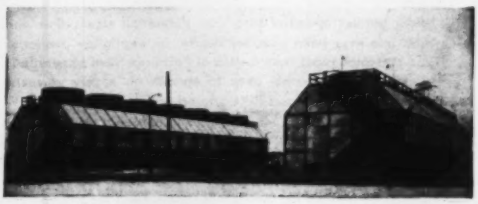
Right Side: Water enters divided water box at valve chamber D, with lower port open. It flows through pass B to end of condenser, back through pass C and out through left port of A.

Left Side: Flow is reversed: Valves at inlet D and discharge A are changed to permit water to flow through C and back through B in the opposite direction, then out through lower port of A.

RECOMMENDED HOTWELL LEVEL CONTROL WITH TUBEJET AIR EJECTOR

This diagram is typical of the information awaiting you in Specification 88. This 4-page illustrated bulletin describes the improved steel shell Tubejet Air Ejectors with combined surface type inter-after condenser. Many power plant engineers are adopting this more reliable, space saving equipment for stationary power plant use. A request on your company letterhead will bring a copy of Specification 88 by return mail.





C. H. WHEELER COOLING TOWERS for MUNICIPAL POWER PROGRAM

Following construction of two 7-cell, 30,000 GPM cooling towers at the Leon Creek Power Station of San Antonio, Texas, C. H. Wheeler was awarded the construction of a third and larger tower. The new tower will handle 55,000 GPM to serve a 60,000 KW generator. It is a 13-cell induced-draft tower designed for 76.5° wet bulb, taking water at 105.5° inlet and cooling it to 90° outlet. Proposed construction is 39'8" x364'x29'. It will resist 30 lbs. per square inch wind pressure, or 100 mph hurricane force. Gibbs & Hill, New York, are the engineers and constructors on the job.

C. H. Wheeler Manufacturing Co., 1840 Sedgley Ave., Philadelphia, Pa.

Extra protection. Autopositive reproductions are used in place of those drawings which would otherwise be exposed to constant wear and tear. These intermediates – with dense photographic black lines on a durable, white paper base – produce sharp blueprints whenever needed.

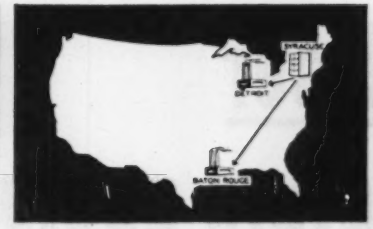


Photo-lasting files. The apparatus and other engineering drawings for Solvay's alkali plants in Syracuse, Detroit, and Baton Rouge – are prepared by the home-office staff in Syracuse, N. Y. Then Autopositive intermediates, which have the lasting qualities of photographs, are made for future reference and print-making requirements.

The Solvay Process Division, Allied Chemical & Dye Corp., reports

New speed and versatility in drawing reproduction ... with Kodagraph Autopositive Paper

Drawing duplication simplified . . . print deliveries speeded . . . new reproduction services provided – these are some of the advantages Solvay Process is realizing with Kodagraph Autopositive Paper.

This new photographic intermediate material reproduces all types of drawings and documents *directly*. In addition, Autopositive increases the utility of existing print-making equipment . . . brings the "plus" features offered by photography alone to many jobs. See how it works for Solvay . . . *see how it can work for you!*

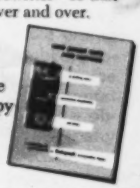
Positive photographic intermediates are produced directly from drawings – no negative step, no darkroom handling. Solvay exposes Autopositive in its blueprint machine . . processes it in standard photographic solutions.

Plant reports prepared quickly. Autopositive intermediates are used as "masters" from which the required number of direct-process prints are made. These intermediates can easily be revised – deletions made and new detail added – by hand or typewriter – so that the basic form can be used over and over.

Costly redrafting eliminated. Old, soiled drawings are reproduced on Kodagraph Autopositive Paper, which intensifies line detail, cleans up backgrounds . . . producing "new-quality" print-making masters *without costly redrafting.*

Contracts expedited. Autopositive intermediates are sent to outside bidders on plant construction projects so that the required number of blueprints needed for quotations can be made. This saves time previously lost when insufficient quantities of prints were supplied.

Get complete details on Kodagraph Autopositive Paper. Write for a free copy of "New Short Cuts and Savings."



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Now . . . even with a large temperature change or drop . . . you can obtain *temperature approaches of 5° to 10° F.*

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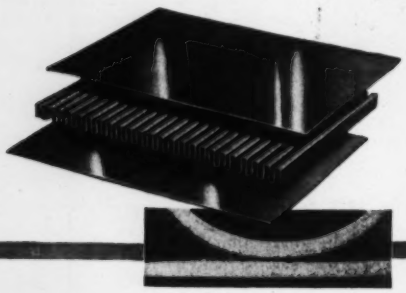
This huge amount of surface in a single unit makes maximum use of available pressure drop. And you don't lose pressure through connections.

TRANE Brazed Aluminum can handle heat transfer between three, four, five or more streams simultaneously —liquid to liquid, liquid to gas, or gas to gas. Temperatures from 500° F. to -300° F. Tested at pressures up to 1000 Psig.

Want more information? Contact your nearest TRANE sales office, or write The TRANE Company, LaCrosse, Wis.



WHAT IS BRAZED ALUMINUM? A stack of flat plates and corrugated fins in layers, all brazed in perfect bond. Strong, light, compact and completely flexible. Illustration below shows strong fillet formed between fin and plate.

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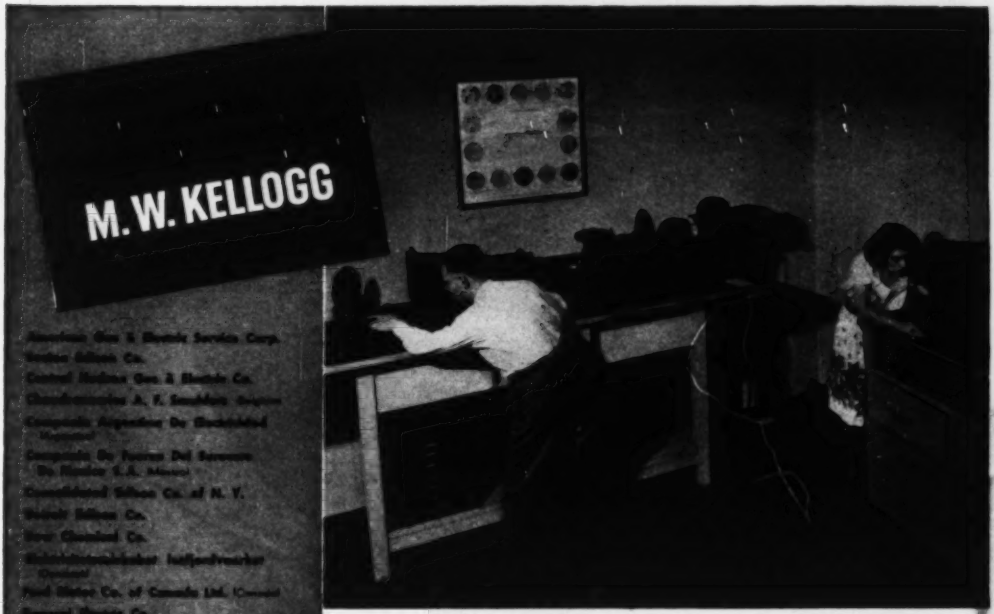

6000 Pictures Looking for "Eyebrows" in critical power piping . . . *because*—

Through the photomicroscope, metallurgists carry on a never-ending search for evidence of graphitization, the phenomenon which prior to 1943 was considered of only academic interest.

They are hunting particularly for what they call the "eyebrow" or chain type of graphite. It is these malformations that cause planes of weakness in carbon steel and carbon moly hi-temp-hi-pressure power piping . . . weaknesses that can result in serious failures.

Since graphitization occurs only after piping has been in high temperature service for sometime, means of precluding its formation can usually be determined only from studies of specimens in which the phenomenon has occurred.

Although the "whys" are unknown, metallurgists have already come up with methods of inhibiting the formation of graphite in carbon steel or carbon moly piping. Annealing welds at about 1300 F appears to help. Addition of chromium to carbon moly analysis piping seems to preclude graphite formation entirely; at least no graphitization has yet been detected in this type of piping which Kellogg recommended for such severe service nearly a decade ago.

Still Kellogg metallurgists continue to research the problem, endeavoring to pinpoint the causes of graphitization and to improve fabricating techniques and materials. More than 6,000 test pieces —cut out of actual service piping —have been polished, etched, photographed and evaluated in the last nine years. Such fundamental knowledge is a valuable *plus* obtained by any utility company when it specifies "Main steam and reheat piping by Kellogg".

OTHER FABRICATED PRODUCTS including:

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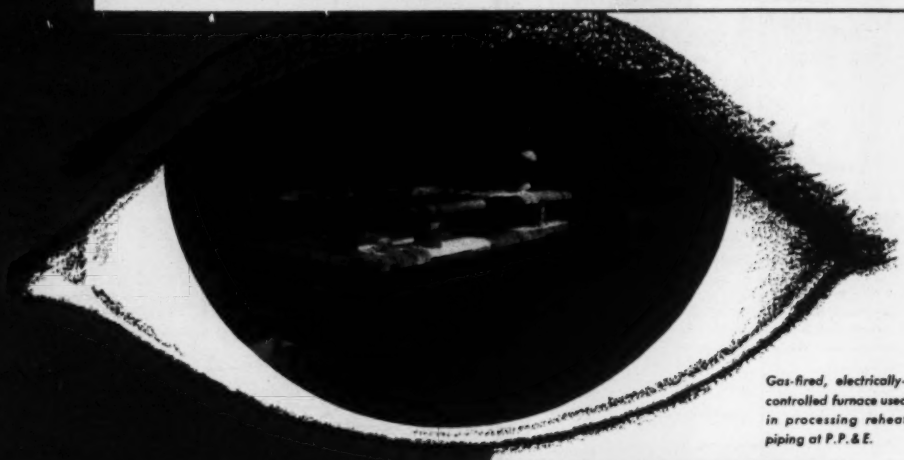
Looking at REHEAT



Gas-fired, electrically-controlled furnace used in processing reheat piping at P.P.& E.

Through Experienced Eyes

Proper piping is essential in order to realize the benefits inherent in reheating steam to higher temperatures—increased volume per pound of water evaporated . . . reduced condensation in lines, casings, cylinders, etc. . . . improved BTU output . . . better fuel economy.

Remember when 750° F. was thought to be a high reheat temperature? Even then P.P.& E. was ahead of the needs in piping that would carry the load. As the trend toward higher temperatures continued, P.P.& E.'s experience accumulated.

That's why the conditions encountered in present-day reheat temperatures over 1000° F. are thoroughly understood by P. P. & E. engineers—and why adequate materials, design know-how, methods of treating and fabricating, and testing procedures are available.

Look to Pittsburgh Piping and Equipment Company for the experience, and the leadership in methods that assure greatest safety, highest efficiency, and longest service from high temperature, high pressure piping.

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World's largest deep frame jaw crusher is protected by Farval lubrication

FARVAL—*Studies in Centralized Lubrication* No. 133

KEYS TO ADEQUATE LUBRICATION—*Wherever you see the sign of Farval—the familiar valve manifolds and dual lubricant lines—you know equipment is properly lubricated. Thus you can see there will be no bearing trouble on this Birdsboro-Buchanan crusher.*

This giant weighs 275 tons, stands 18 feet high, has a 66- x 84-inch jaw opening. It handles feed from a 5-cu.-yd. shovel, discharging a 14-inch product at the rate of 800 t.p.h. It is one of more than fifty thousand industrial machines whose bearings are protected by Farval.

Photo above by courtesy Birdsboro Steel Foundry & Machine Co.

IN the next few months, this mammoth machine will crush three million tons of diorite. Largest deep frame jaw crusher ever built, it is operating on the Detroit dam project in western Oregon.

A highly publicized feature of this project is the cooling of all the aggregates used in the concrete construction. The builder of this crusher insured that the bearings in his equipment would always run cool, too. He equipped it with a Farval Centralized Lubrication System.

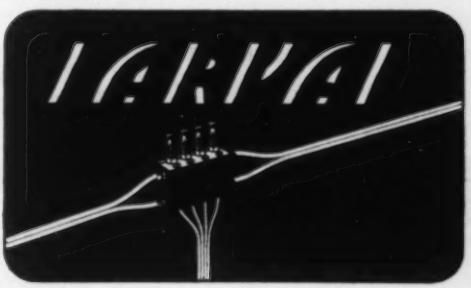
With Farval on the job, no special oilers are needed, lubricant consumption is reduced, bearing life is extended indefinitely and shutdowns for oiling or bearing replacement are eliminated. In short, Farval insures that the crusher can work day in, day out, without interruption from overheated bearings, in doing its part to see that the great Detroit dam is finished according to schedule.

Farval is the original Dualine system of centralized lubrication for industrial equipment, proved practical in 25 years of service. The Farval valve has only two moving parts—is simple, sure and foolproof, without springs, ball-checks or pinhole ports to cause trouble. Through its full hydraulic operation, the Farval system unfailingly delivers oil or grease to each bearing—as much as you want, exactly measured—as often as desired. Indicators at all bearings show that each valve has functioned.

In or near your city there's a Farval engineer, ready to discuss your lubrication problems and suggest a proper system to meet your particular needs.

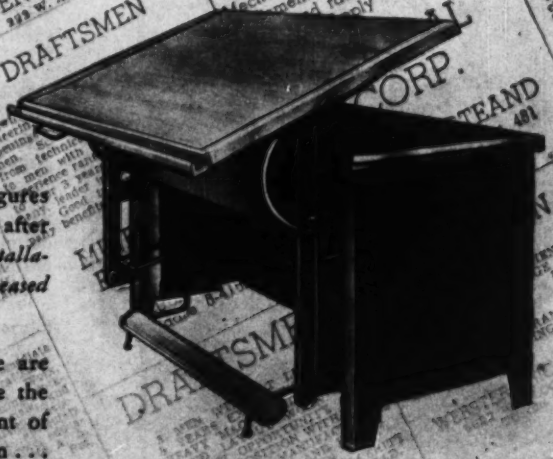
The Farval Corporation, 3264 East 80th Street, Cleveland 4, Ohio.

Affiliate of The Cleveland Worm & Gear Company, Industrial Worm Gearing. In Canada: Peacock Brothers Limited.



When 3 draftsmen must do the work of 4—

Hamilton Auto-Shift tables are often the answer!



Exact drafting room productivity figures are difficult to develop, but in case after case we have been told that the *installation of Hamilton Auto-Shift tables increased production 20%, 30% and more.*

Impressive performance, and there are good reasons for it. Reasons like the instant, almost effortless adjustment of the Auto-Shift to any board position . . . and the sharp decrease in draftsman fatigue this brings about. Or the unique reference system utilized when Auto-Shifts are used in banks, and each unit furnishes a working-side reference surface for the next board in the bank. Or the simplicity and complete adequacy Auto-Shift offers for at-the-board conferences.

Like all Hamilton equipment, Auto-Shift tables are *work-designed* from a complete and intimate knowledge of drafting room operation and requirements. Available on reasonable delivery schedules, they offer you a solidly-built investment in increased productivity. *Be sure to get the complete Auto-Shift story from your Hamilton Representative soon.*

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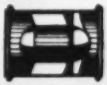
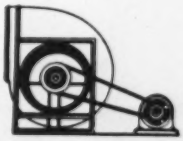
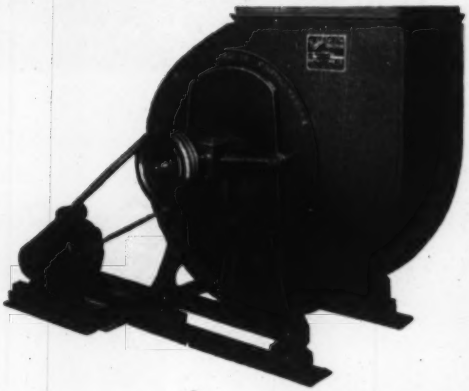
MAKING THE RIGHT SELECTION

AXIAL FLOW?  or CENTRIFUGAL? 



Centrifugal fans like this "Buffalo" Limit-Load model are generally the first choice for large ventilation, exhaust and air conditioning systems. Their efficiency is high even when installation is at a curve in the duct. Medium speed fans, they are ideal for handling large volumes of air quietly at medium pressures. "Buffalo" Limit-Load Fans have the additional advantage of being non-overloading, regardless of the system pressure. For further factors in the selection of a centrifugal fan, write for Bulletin 3737.

"Buffalo" BUILDS BOTH TYPES

Axial Flows, on the other hand, move air by the propeller principle, straight through the fan housing. These fans will thus be most efficient mounted in straight runs of duct. They are ideal for light-duty ventilation and air conditioning service at pressures to around 2". Axial flows are higher velocity fans than centrifugals, are lighter weight and more compact than centrifugal fans, therefore lower cost for duct-mounting on ceilings, walls, etc. However, the performance curve is often the last analysis in your choice of fan for each job. "Buffalo" Bulletin 3533-C contains a comparison performance chart of both "Buffalo" Limit-Load Fans and Axial Flows. A copy will be mailed to you on request.

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FORCED DRAFT COOLING HEATING PRESSURE BLOWING

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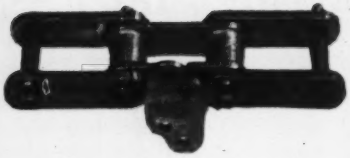
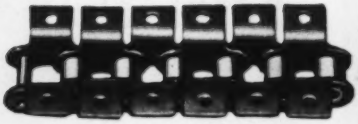
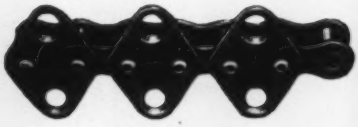
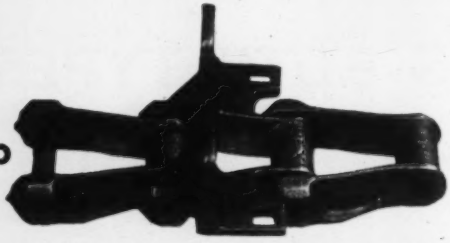
help  ...help 

help ...help 

help  ...help

Here's plenty of "HELP" for you if your design problem involves the movement of material to, through, and away from a machine. CHAIN and ATTACHMENTS are the biggest "HELP" you can find.

In the complete CHAIN BELT COMPANY line of more than 2000 sizes and types of chain . . . *and every type has a number of attachments* . . . you'll find exactly what you need for most efficient product movement . . . greatest design flexibility. And, because the line *is* complete, you can choose the chain that will reduce costs—improve performance—insure customer satisfaction.

If exact, split-second timing is your problem, Baldwin-Rex® precision finished roller chain is your answer. If low initial cost is important, Rex® Cast Chain will meet this requirement. If heavy loads at slower speeds are your problem, a Rex Chabelco®

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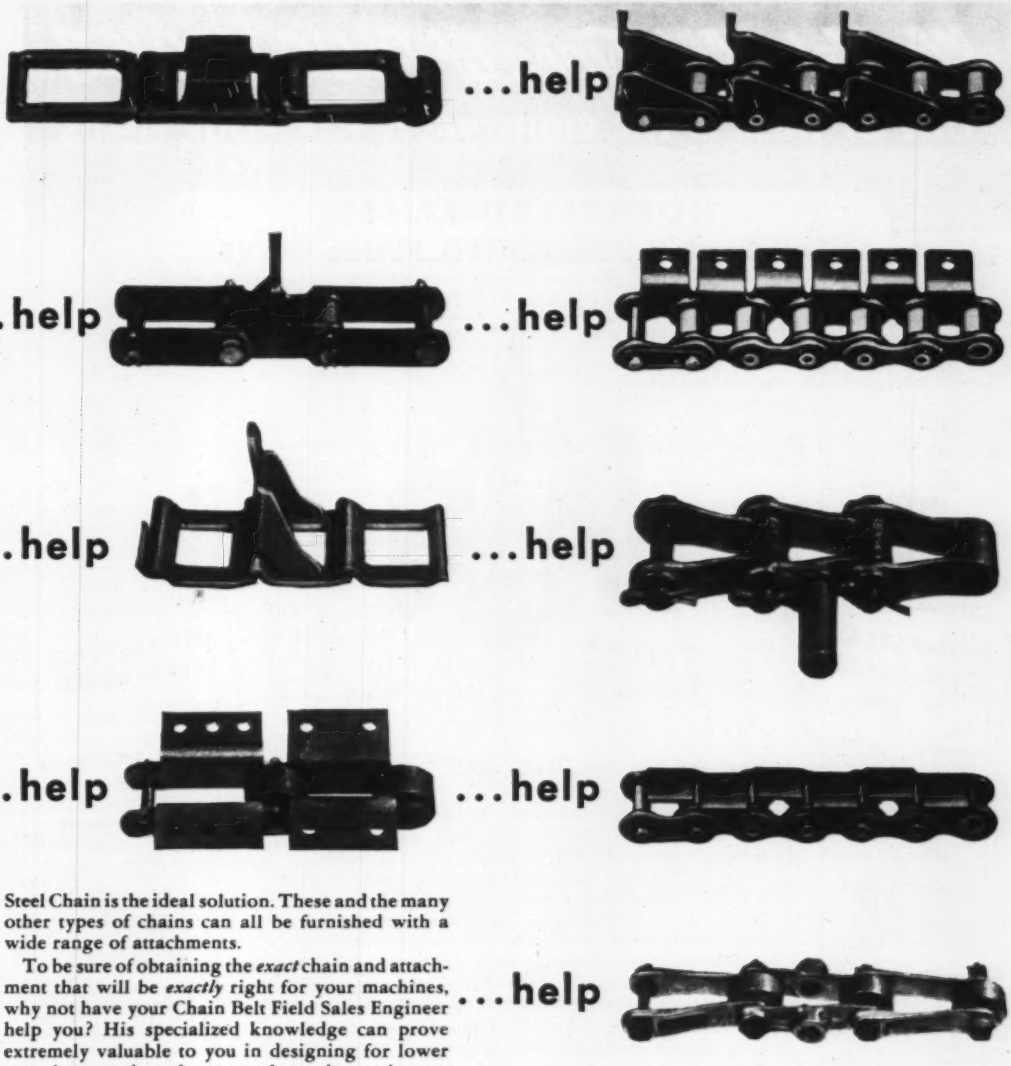

Steel Chain is the ideal solution. These and the many other types of chains can all be furnished with a wide range of attachments.

To be sure of obtaining the *exact* chain and attachment that will be *exactly* right for your machines, why not have your Chain Belt Field Sales Engineer help you? His specialized knowledge can prove extremely valuable to you in designing for lower cost, improved performance from the equipment you design. Or for helpful information, mail the coupon below.

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HOMESTEAD-REISER "Self-Seald" LUBRICATED PLUG VALVES

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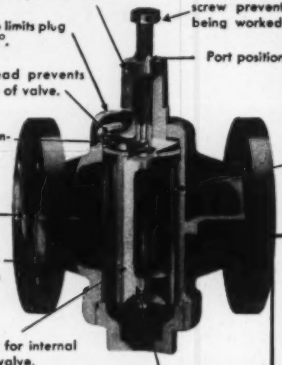
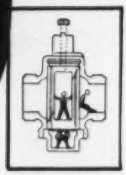
Worm & Gear Operated


Quarter-turn opens or closes.
Full threaded lubricant screw prevents dirt from being worked into valve.
Outside stop limits plug travel to 90°.
Port position indicator.
Pressure-sealed head prevents leakage around top of valve.
Stainless thrust shim eliminates gasket wear.
Self-Seald — Wedge action of divided plug gives extra tight seal against leakage.
Straight line fluid flow. Streamlined ports.
100% port seal; lubricant fully surrounds valve ports.
Automatic adjustment for internal wear extends life of valve.
Sealing surfaces protected from corrosive or erosive line fluids.



Flow Changer—
Non-lubricated

HOMESTEAD CAM-SEALD (dry seat)

HOMESTEAD LEVER-SEALD (quarter turn)

How the Amazing "Self-Seald" Principle Works

Homestead-Reiser's patented "Self-Seald" principle is, we believe, the simplest and most effective sealing principle yet developed for lubricated plug valves.

In addition to a full lubricant seal around the ports, and around the top and bottom of the valve, the wedge-action of the divided plug under line pressure, causes the finely-finished surfaces of both segments of the plug to press outward against the sealing surfaces of the body.

This self-sealing action keeps the plug surfaces in contact with the mirror-like bore of the body. The plug automatically adjusts itself for wear, thus assuring extra long life and maximum leakless service.

For complete information, sizes and prices, write for Catalog 39-S. No obligation.

Straight-way—
Flanged or Screw Ends

Straight-way—
Flanged or Screw Ends

Three-way—
Screw or Flanged Ends

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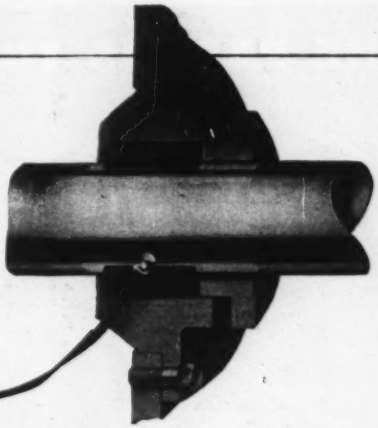

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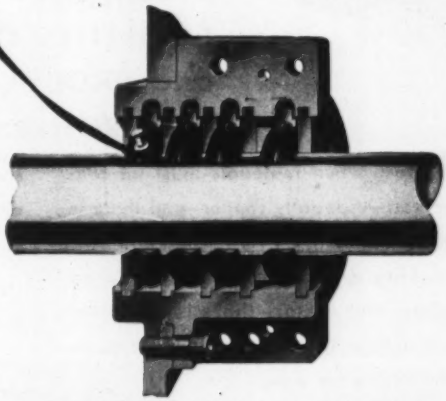

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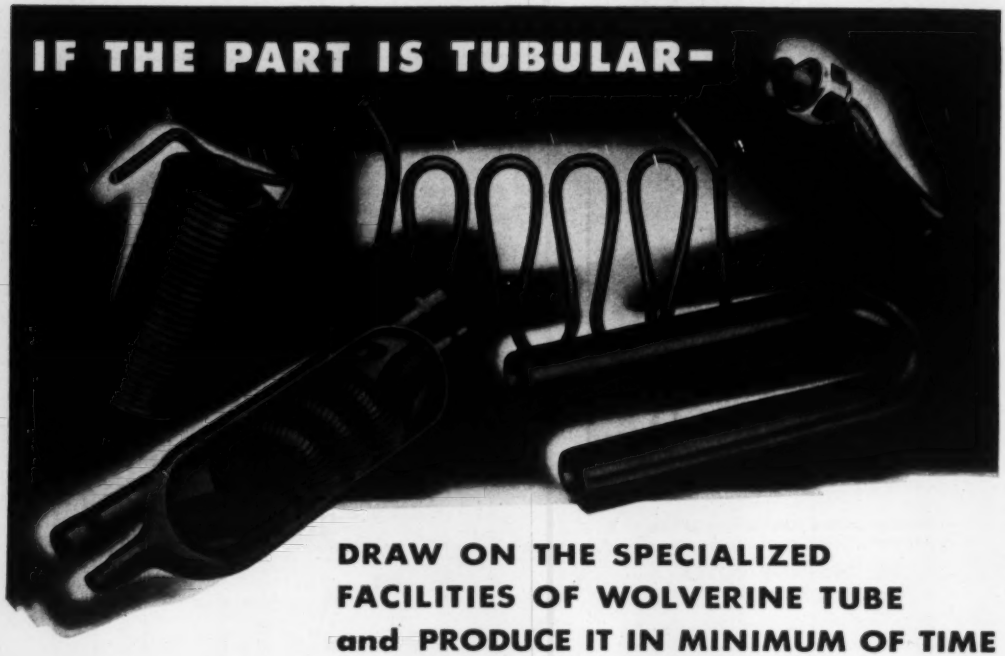

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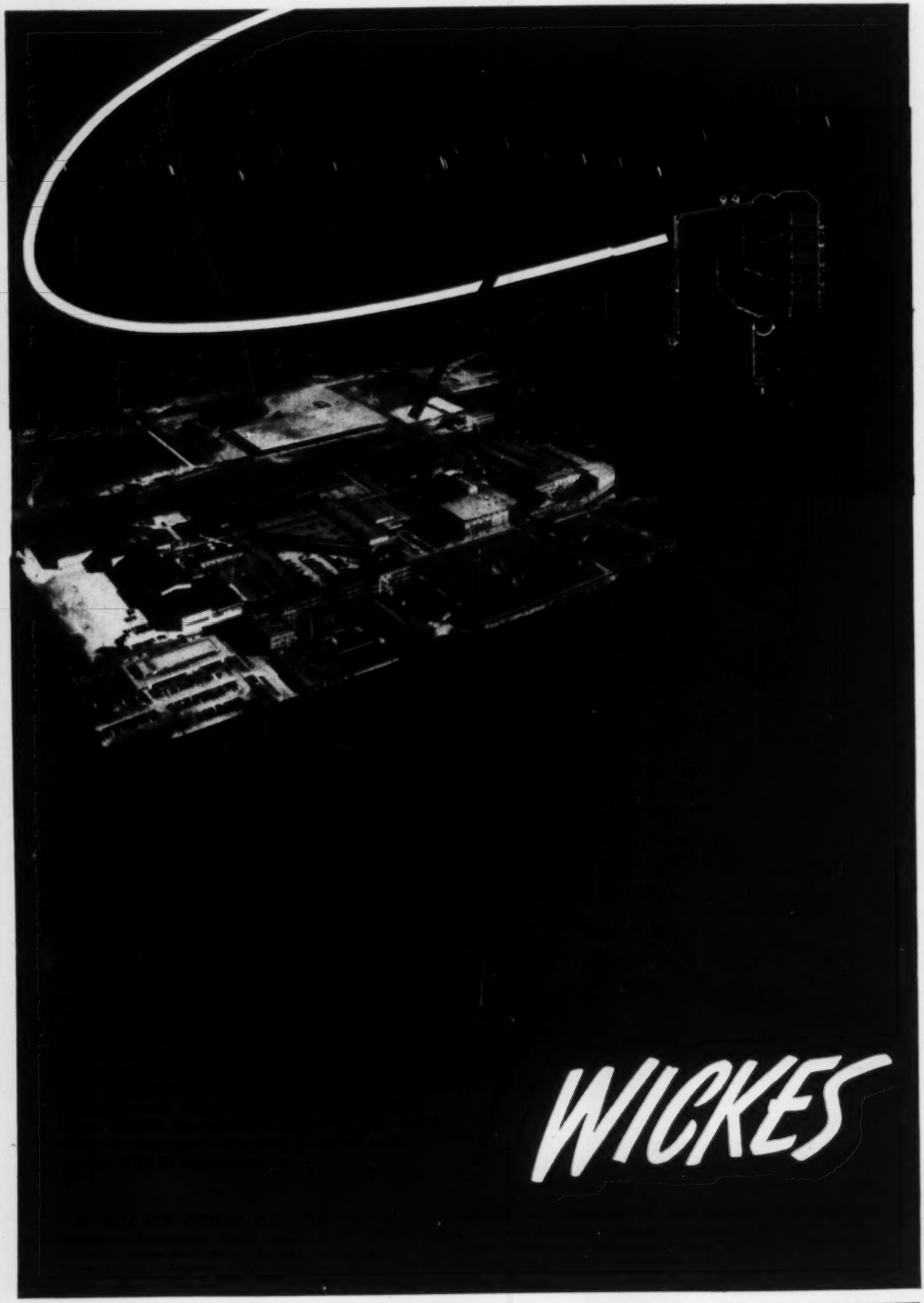
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Manager Toledo Laundry

Here's the Record

Fuel costs down 33.9%

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Iron Fireman

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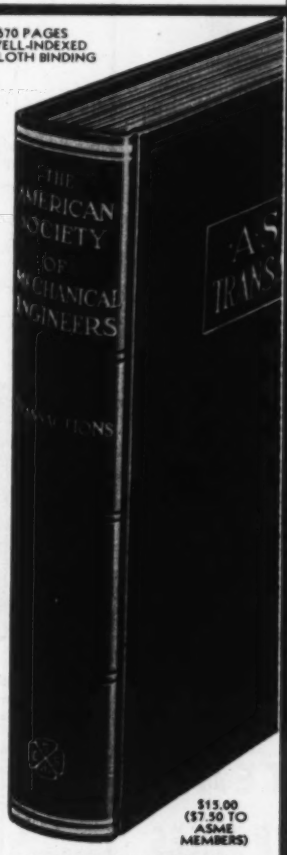

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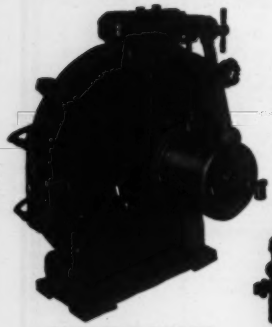
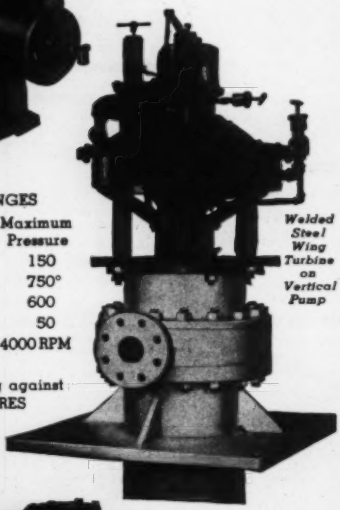


OPERATING RANGES

	Standard	Maximum Pressure
Horsepowers	100	150
Temperatures	525°	750°
Pressures	275	600
Back Pressures	50	50
Speeds	4000 RPM	4000 RPM



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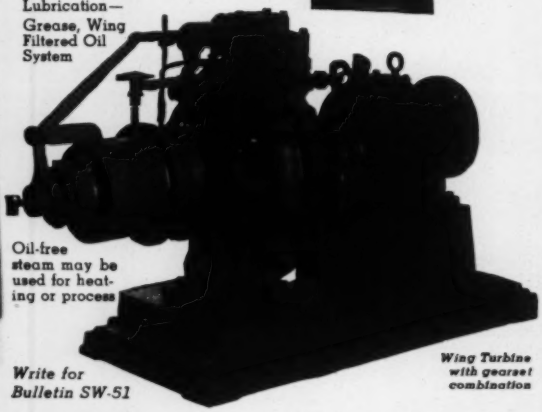
Capable of exhausting against HIGH BACK PRESSURES

Shafts—Horizontal or vertical

Rotation—Clockwise or counter-clockwise

Lubrication—Grease, Wing Filtered Oil System



Oil-free steam may be used for heating or process

Write for Bulletin SW-51

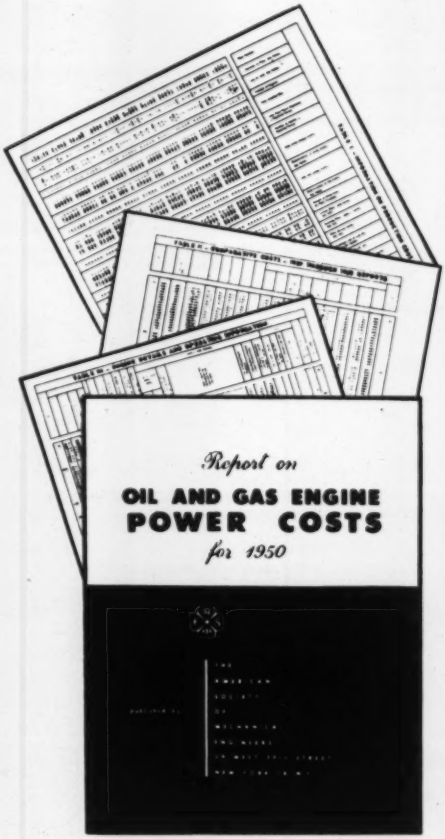
Wing Turbine with gearset combination

L. J. Wing Mfg. Co. 156 Vreeland Mills Rd.
Linden, New Jersey
Factories: Linden, N. J., Montreal, Canada

Wing AUXILIARY STEAM TURBINES

DIESEL USERS

A study of the production and performance statistics in this 1950 Report on Oil and Gas Engine Power Costs may suggest ways and means of reducing costs in your plant.



Assembled from reliable sources and covering 146 plants containing 466 oil engines, 64 dual-fuel engines and 6 gas engines, the information is presented in three comprehensive tables: 1, showing items affecting production costs; 2, giving comparative costs for plants submitting data for two or more successive years; 3, providing engine details and operating information.

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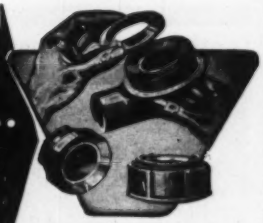

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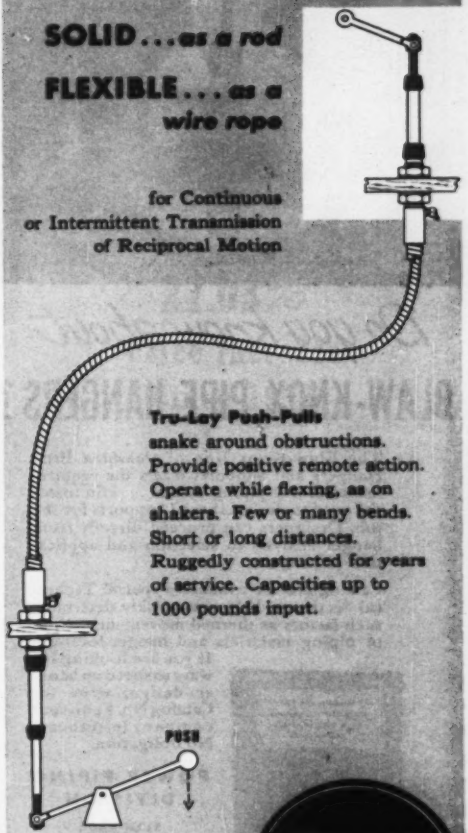

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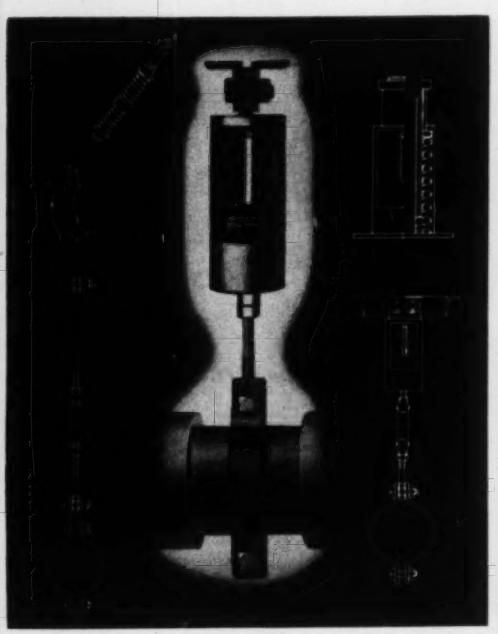

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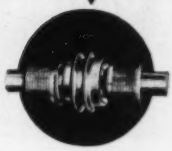

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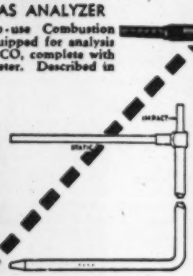

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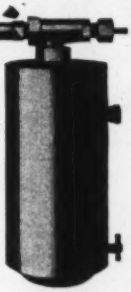

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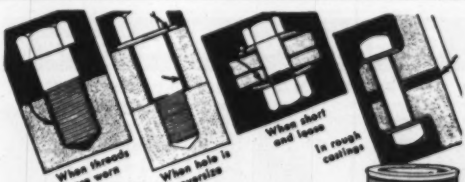

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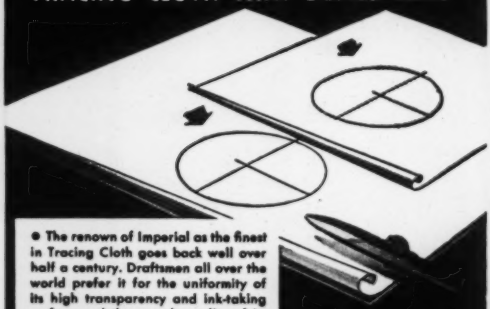

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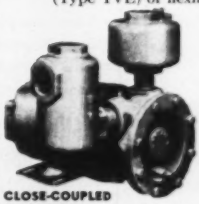

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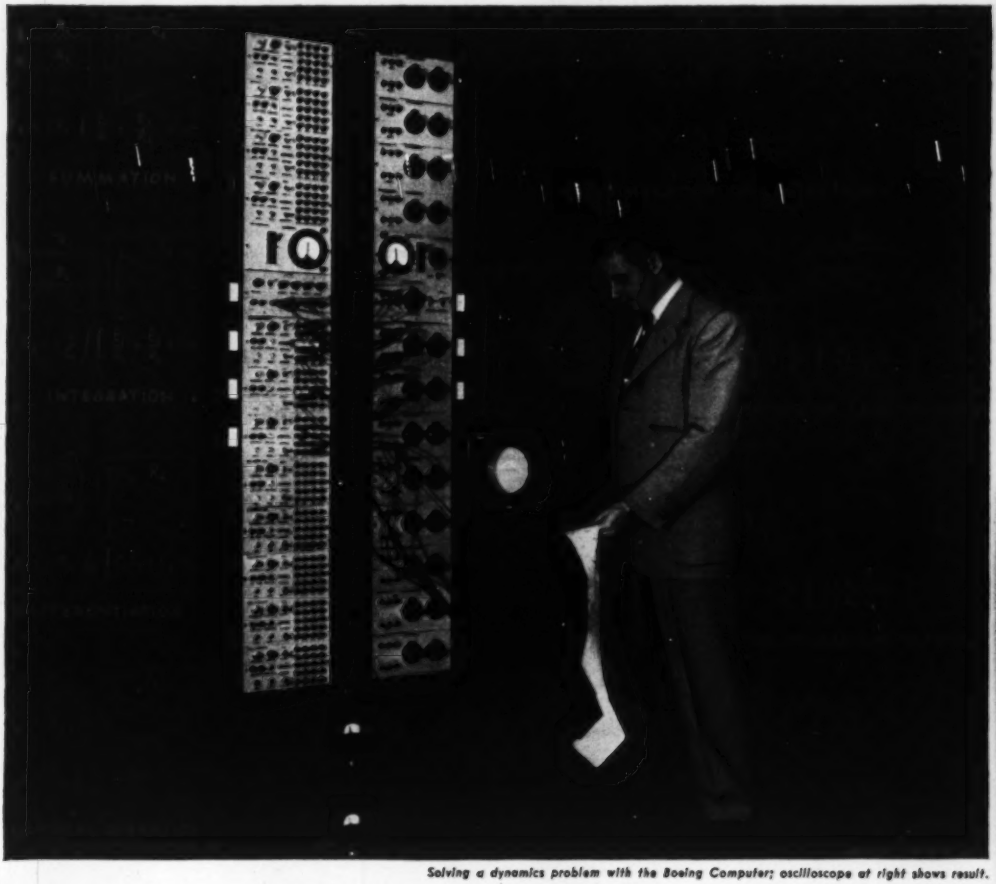

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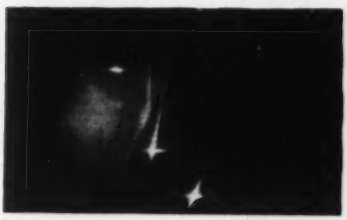

4 Diffraction pattern of polished germanium reveals minute impurities which would degrade the performance of a Transistor.

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Advertisers in previous 1952 issues but not in this issue

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*Air Preheater Corp.
*Allis-Chalmers Mfg. Co.
*American Flexible Coupling Co.
*American Manganese Bronze Co.
American Pencil Co.
*American Pulverizer Co.
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*Bin-Dicator Co.
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*James, D. O., Gear Mfg. Co.
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*Keckley, O. C., Co.
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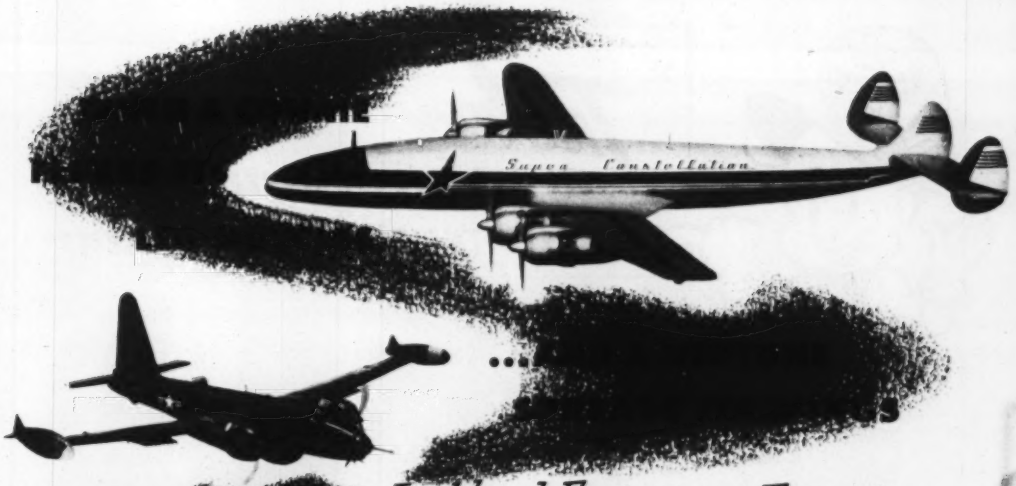
Wiley, John & Sons
Winsmith, (Inc.)
*Zallea Brothers
*Zurn, J. A., Mfg. Co.



Lockheed Engineering Turns to Chiksan to Turn the Trick

THE SUPER CONSTELLATION, newest in Lockheed's fleet of transports, and the Navy's newest Neptune, tough-taloned bird of prey, are both evidence that we can "Look to Lockheed for Leadership". Both rely upon Chiksan Ball Bearing Swivel Joints to turn corners in their hydraulic systems — to flex their metal joints.

Chiksan takes such tough assignments in its stride. For Chiksan Hydraulic Joints are made for jobs where precision is the rule. Although used in 1, 2, and 3,000 psi systems these joints are tested by Chiksan's Research and Development Department in the presence of bitter cold and searing heat — under pressures as high as 10,000 psi and under the relentless driving force of continual use.

Whether the job is to keep planes flying or industry's life-blood flowing — to hasten manufacturing process and expedite transportation — to feed the veins of industry and speed the course of science and invention, there you will find Chiksan applications — Ball Bearing Swivel Joints tooled to exacting tolerances, flexing the muscles of Progress — adding sinew and flexibility to the flow of gas, liquid and modern living.

If plant, process or product needs speeding or improving — if flow of liquid or gas or flexibility of metal is a factor, call upon the Research and Development Division of Chiksan. There's probably a better method awaiting your service that Chiksan has proved in performance or can devise for your special need.

CHIKSAN
TRADE MARK REG.

Representatives in principal cities
Write today for Catalog 2A "Aircraft Swivel Joints" — Dept. 4-M.E.

CHIKSAN COMPANY • BREA, CALIFORNIA • Chicago 28, Illinois • Newark 2, New Jersey

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"Trabon OIL AND GREASE SYSTEMS SOLVE THE DESIGNERS' PROBLEMS"

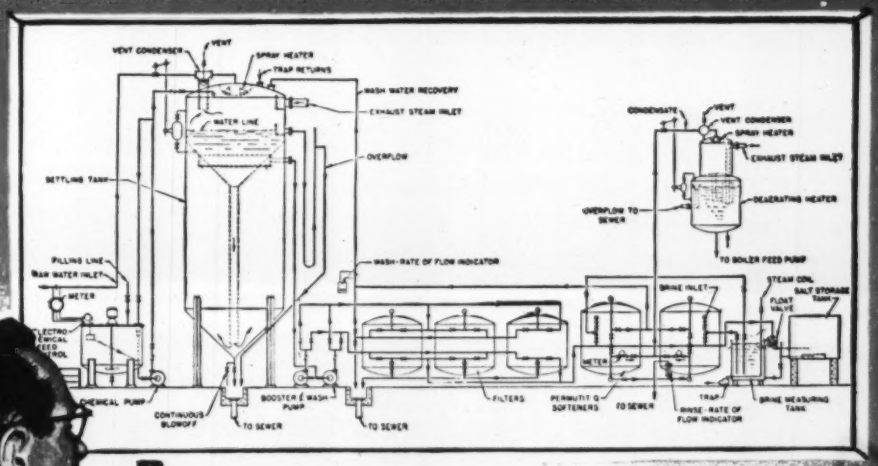
How Would You Lubricate the Bearings on this Machine? *The bearings are inside...concealed...hard to reach...*

This machine is lubricated by a Trabon automatic pump which delivers the exact amount of lubricant to each bearing. The Trabon system is equipped with a warning device which notifies the operator when trouble occurs... the pump starts and stops with the machine.

Include Trabon trouble-free, positive lubrication in the machines you design.

Trabon
OIL AND GREASE SYSTEMS

TRABON ENGINEERING CORPORATION
1814 East 40th Street • • Cleveland 3, Ohio



"...have you heard about Permutit's New Hot Zeolite Process?

"Permutit announced the process only a few months ago, but already we're putting it to good use in our plant. We think it's the best way of producing water that's low in alkalinity and silica . . . and with all hardness removed."

"Say, Ed, that's really something . . . getting an effluent of zero hardness from a hot lime soda softener! How's it possible?"

"Well, you see, Joe, they've developed a new mineral, Permutit Q. It's an ion exchanger that will withstand boiling water with a pH over 10, and it's not affected under operating conditions like that even after 1300 regeneration cycles."

"Tell me more! Is Permutit Q more economical than phosphate?"

"It is, and what's more, it reduces CO_2 in the steam. I'm really sold on this new process, because our chemical costs are lower, our effluent is lower in alkalinity and total solids, and we don't need acid feeding to prevent deposits in our high stage heaters and economizers."

"The more you tell me, Ed, the more I want to know. I think we could put this new hot zeolite process to work in our plant, too. How can I find out full information about it?"

"If you write to Permutit, they'll send you a new bulletin *full* of information. I have their address somewhere . . . oh yes! It's The Permutit Company, Dept. ME4, 330 West 42nd Street, New York 36, N. Y. Then there's the Permutit Company of Canada, Ltd. at 6975 Jeanne Mance Street, Montreal."

"Thanks for the tip, Ed. I'm sending them a letter today!"

Water Conditioning Headquarters for Over 37 Years

PERMUTIT

Simmons switches to TIMKEN® bearings, gets more accuracy in 6" boring and facing machine

WHEN the Simmons Machine Tool Corporation redesigned their old, plain bearing 6" horizontal boring and facing machine they wanted it to work to the closer tolerances required today.

To insure the spindle rigidity which would make accurate machining possible, Simmons engineers mounted the machine's boring bar sleeve spindle on Timken® precision bearings. Timken bearings are also used in the following applications: boring bar steady rest, saddle feed assembly, worm gear shaft, feed sprocket shaft, input shaft, first and second intermediate shafts.

Timken precision bearings are made specifically for precision spindle applications. "Double Zero" bearings are available with run-out tolerances of 75 millionths of an inch or less.

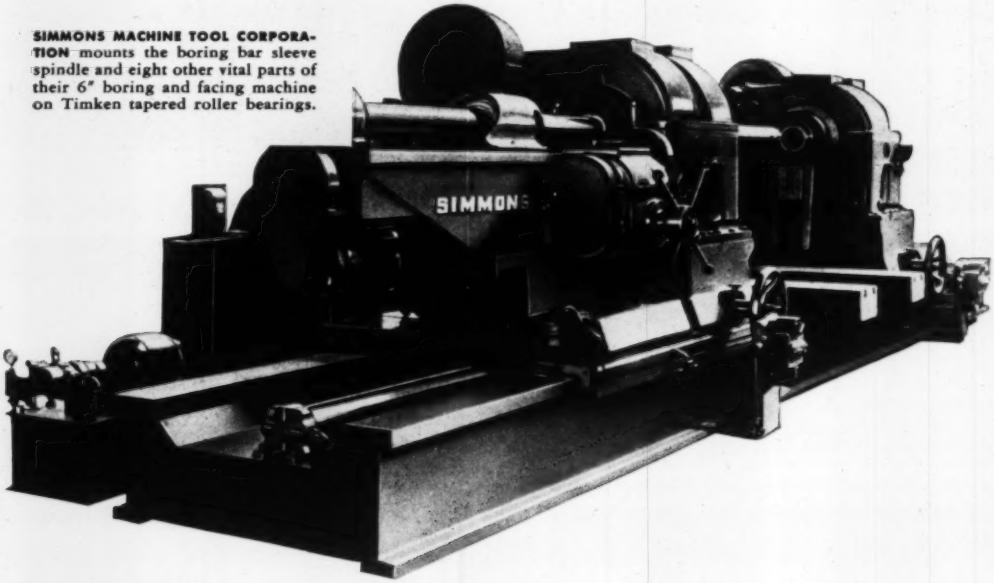
Because of their tapered design, Timken bearings permit pre-loading to any desired degree, preventing chatter. Because of line contact between Timken bearing rollers and races, there's more than enough capacity for any tool load.

Timken bearings reduce machine tool manufacturing costs too. Assembly and set-up of the bearings are quick and easy. No special thrust bearings are needed.

No other bearing offers you all the advantages that Timken bearings do. Look for the trade-mark "Timken" on every bearing. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.

SIMMONS MACHINE TOOL CORPORATION mounts the boring bar sleeve spindle and eight other vital parts of their 6" boring and facing machine on Timken tapered roller bearings.



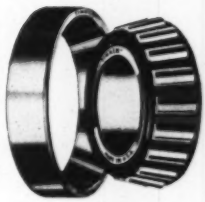
FINISHED TO CLOSER TOLERANCES

Finishing to incredible smoothness accounts for much of the precise, smooth rolling performance of Timken bearings. This honing operation is typical of the amazingly accurate manufacturing methods at the Timken Company.

The Timken Company is the acknowledged leader in: 1. advanced design; 2. precision manufacturing; 3. rigid quality control; 4. special analysis steels.

TIMKEN

TAPERED ROLLER BEARINGS



NOT JUST A BALL ○ NOT JUST A ROLLER ▭ THE TIMKEN TAPERED ROLLER ▭ BEARING TAKES RADIAL ⊕ AND THRUST ⊕ LOADS OR ANY COMBINATION